SCIENCE

FRIDAY, MARCH 12, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A LECTURE BY REGNAULT.

WHEN a student at the Collége de France in 1847 I heard a lecture by Victor Regnault, of a part of which I send a copy. So far as I know, it was never printed. The lithographed copies were paid for by the students themselves. I think that the figures of prisms given (see plate) will have something more than a purely historical interest even now.

WOLCOTT GIBBS.

NEWPORT, January 27, 1897.

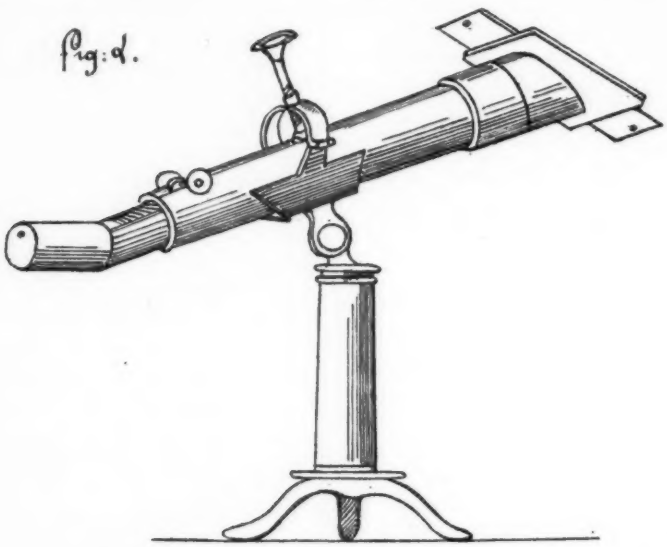
Quelques physiciens ont construits des appareils au moyen desquels on peut observer les raies du spectre sans qu'il soit necessaire de se placer dans une chambre obscure.

A l'une des extrémités d'un tuyau, Mr. Dujardin place un diaphragme rectiligne; à l'autre extrémité, un certain nombre de prismes fixés dans la position du minimum de déviation, en les disposant ainsi, il a pour but de diminuer autant que cela est possible, l'aberration de sphéricité qui résulterait de ce que les rayons incidents ne sont pas paralléles.

On obtient ainsi un spectre très dévié, mais cette disposition présente plusieurs inconvénients; la déviation minimum n'a lieu que pour les rayons qui marchent dans l'axe du tuyau; de plus, quoi que l'on ait diminué le plus possible l'épaisseur des prismes les pertes de lumière par réflexion

sur leurs faces, sont encore assez considérables.

Mr. Mathiessen a fait disparaître ces inconvénients au moyen de l' appareil qui est représenté par la figure (*a*).



Il se compose essentiellement d 'un lentiprisme (Fig. B.), c'est-à-dire d 'un prisme dont une des faces est lenticulaire. Cette face est perpendiculaire à l'axe d 'un tuyau qui porte le prisme à l 'une de ses extrémités et qui est réuni à l'autre bout d'un diaphragme rectiligne. Les rayons lumineux en traversant la face lenticulaire sont ramenés au parallélisme et arrivent à la face postérieure en faisant tous un angle à peu près égal à celui de la réflexion totale. Ils emergent par consequent presque parallèles à cette seconde place. L'effet du lentiprisme ressort des figures A. B. C. dessinées par Mr. Mathiessen. La fig. A. montre comment un prisme ordinaire qui reçoit un faisceau de rayons non parallèles et qui est placé dans la position du minimum de déviation par rapport aux rayons centraux, produit encore une aberration de sphèricité considérable, parcequ'il ne remplit pas la même condition à l'égard de tous les rayons. Grâce à la face lenticulaire du lentiprisme B, qui rend les rayons parallèles avant leur arrivée à la face de sortie, l'aberration de sphèricité se trouve évitée; il ne reste que l'aberration de réfrangibilité qui importe peu, parcequ'il n'est pas nécessaire d'observer toutes les couleurs en un même point. Le système C, composé d'une lentille et d'un prisme pourrait produire un effet analogue à celui du lentiprisme mais pour produire la même dispersion sur un faisceau incident de même ampleur, il devrait avoir une masse beaucoup plus considérable. On peut encore empêcher l'aberration de refrangibilité par l'addition de lentilles disposées de façon à produire une sorte d'achromatisme.

Cette modification se trouve réalisée dans les figures F et G, qui représentent, en outre le lentiprisme composé. Ce lentiprisme composé a permis à Mr. Mathiessen d'obtenir une dispersion plus considérable qu'avec le prisme simple. Et c'est ainsi qu'il a pu

étendre les parties extrèmes du spectre au delà des limites observées par Fraunhofer. Les nouvelles parties du spectre, avec leur raies sont représentées dans la Fig. 4, qui est la reproduction du dessin communiqué par Mr. Mathiessen.

PROFESSOR FONTAINE AND DR. NEWBERRY ON THE AGE OF THE POTOMAC FORMATION.

THE appearance at this time of two important works on the Potomac formation, though both of them have been long delayed in publication, is peculiarly opportune in view of the discussion now going on in relation to the age of that formation. These works are first, that by Professor Fontaine on the Potomac Formation in Virginia,* and second, that of Dr. J. S. Newberry, on The Flora of the Amboy Clays.†

The greater part of the matter of the first of these works was originally submitted by Professor Fontaine as an introduction to his important work on The Flora of the Potomac Formation,‡ giving a somewhat detailed account of the stratigraphical relations of the Potomac formation in Virginia. But it was thought best to omit this introductory part and publish it separately. Owing to causes which need not be here enumerated, the publication of this part of his work was long neglected, but is now hapily before the scientific world.

As its name implies, this treatise is confined mainly to those portions of the Potomac formation which lie south of the Potomac River, *i. e.*, almost exclusively to the State of Virginia, and only contains incidental references to the condition of things in Maryland. A consequence of this is that it deals wholly with the Older Potomac and does not attempt to discuss the prolongation of the formation through New Jersey and northeastward, where all the beds thus far found belong to the Newer Potomac, which finds its greatest exemplification in the Raritan and Amboy Clays.

The second of these works, on the contrary, deals exclusively with the Newer Potomac, but under the term Amboy Clays Dr. Newberry expressly included all that was known to him of those beds which occupy the north shore of Long Island and are found all the way from Staten Island to Marthas Vineyard. Although I have designated these latter beds as the Island Series, and have sufficiently demonstrated the justness of this subdivision, I have at the same time admitted that the character of the flora is substantially the same throughout.

We thus have two new contributions to the subject under discussion written by able men who are not exclusively nor chiefly paleobotanists, but are known to the world as geologists of the first grade, each of whom prior to writing his work had devoted many years to an exhaustive study of the formation to be dealt with. Although much has been learned since the date at which these works were written, it is not proposed in this paper to make special reference to such discoveries, as they have been for the most part fully set forth in a series of papers by Mr. David White, Dr. Arthur Hollick and myself, an acquaintance with which will be assumed on the part of the reader.* But

* The Potomac Formation in Virginia, by William Morris Fontaine, Bull. U. S. Geol. Surv., No. 145, Washington, 1896.

† The flora of the Amboy Clays, by John Strong Newberry. A posthumous work, edited by Arthur Hollick. Monographs of the U. S. Geological Survey, Vol. XXVI., Washington, 1896 (erroneously dated 1895).

‡ The Potomac or Younger Mesozoic Flora, 2 Vols. text and plates. Monographs of the U. S. Geological Survey, Vol. XV., Washington, 1889.

* See Bull. Geol. Soc. Am., Vol. I., p. 554; Vol. VII., p. 12; Am. Journ. Sci., 3d Ser., Vol. XXXIX., p. 93; Trans. N. Y. Acad. Sci., Vol. XI., p. 96; Vol. XII., p. 1, 222; Vol. XIII., p. 122; Bull. Torr. Bot. Club, Vol. XXI., p. 49; Fifteenth Ann. Rept. U. S. Geol. Surv., p. 307; Sixteenth Ann. Rept. U. S. Geol. Surv., p. 463.

the treatises here mentioned give the matured views of their authors, and in the case of Dr. Newberry this work constitutes almost his last contribution to science. I would therefore ask the privilege of directing the attention of those geologists who are interested in the discussion of the age of the Potomac formation to the opinions of these two authors, and I have no apology to make for quoting somewhat freely from them. I will also take the liberty of italicizing, on my own responsibility, those passages which I regard as bearing most directly upon the subject.

When Professor Fontaine commenced his studies he was confronted by the views of Professor Rogers, who, although he had recognized the clear distinction between the Triassic formation and the higher Mesozoic beds and had designated the former as 'Jura-Trias' and the latter as 'Jurasso-Cretaceous,' inclined to regard the whole as belonging below the Cretaceous. It therefore required paleontological evidence to settle the question. Some fossil plants had been found in the Trias which were determined by Bunbury, but, on account of the imperfect material and of the little that was then known of the Mesozoic floras, he was disposed to regard them as indicating an age similar to that of the Oolite of Yorkshire. This view had been completely disproved by Professor Fontaine's previous studies of 'The Older Mesozoic,' as embodied in his work on that flora,* and he had correlated it with those transition beds in Europe and other countries which lie on the border of the Triassic and Jurassic and are known as Rhetic. Since that work was published Stur discovered at Lunz, in Austria, a flora which corresponds still more closely with that of America, even containing a number of the same species, the beds yielding it having been definitely fixed in the Upper Keuper, and we may now look upon this as the more correct correlation.* After giving an account of the manner in which the fossil plants of the Younger Mesozoic were discovered and of their general character Professor Fontaine says (p. 14): "None of these fossils have been found in the Richmond coal field, and, so far as known, *none of the supposed older Mesozoic areas contain any of them.* It is sufficient to say here that this flora indicates that the Potomac beds were laid down in a period *decidedly more recent* than that in which the middle secondary strata of Rogers were deposited." Again, on p. 142, referring to the same subject, he says:

"In Virginia the youngest formation upon which the lower, or sandy member of the Potomac is seen to rest, is the older Mesozoic or Rhetic formation. The interval of time, however, between the deposition of the Rhetic and the deposition of the Potomac beds must have been a considerable one. There are several reasons for coming to this conclusion: (1) Where the superposition of the Potomac on the Rhetic is visible the latter is seen to have been greatly worn before the deposition of the former. (2) The lithologic and structural character of the two formations is very different, implying a total change in the conditions of deposition. (3) The Rhetic is made up of sandstones and shales which are distinctly bedded, so that the dip and strike can be easily made out. The materials composing these beds were well sorted by water action. Before the deposition of the Potomac the Rhetic strata had been consolidated and, in the main, indurated, so as to form firm sandstones and shales, or even slates. The Rhetic beds are in many places crushed, contorted, and faulted, all of which changes took place before the Potomac age. No traces of them

*The Older Mesozoic Flora of Virginia. Monographs of the U. S. Geological Survey, Vol. VI., Washington, 1883.

*Cf. Bull. Geol. Soc. Am., Vol. III., p. 31.

are found in the Potomac. The Rhetic is also penetrated by numerous dikes of igneous rock, none of which pass into the Potomac beds. The interval of time separating the two formations must, then, have been long enough to permit the occurrence of important geologic changes. These resulted in the draining off of the Rhetic waters and in the lateral compression of the Rhetic areas, which caused crumpling and faulting of the strata and outpours of igneous rock. The Rhetic basins were elevated and formed into dry land, subjected to great erosion, and the most eastern of them then depressed and brought under water again. *Certainly no Rhetic species of plant survives into the Potomac.*"

From all this it is apparent that the Older Mesozoic or Triassic formation of the Atlantic border has really nothing to do with the Potomac formation. Only in a few places, as through parts of New Jersey and in Virginia for a short distance in the vicinity of the North Anna and South Anna Rivers, are the two formations in contact, and here the latter rests in complete unconformity upon the former. At all other points they are separated by an interval of greater or less width of the old crystalline rocks. This shows that the Trias, as well below the Hudson as in the Connecticut Valley, constitutes a trough and forms no part of the Coastal Plain proper, having its affinity much more closely with the Piedmont Plateau. The fact that not a single Triassic species passes up into the base of the Potomac further proves that that interval must have been an exceedingly long one, and it is quite in conformity with the facts to suppose that it embraced the entire Jurassic period.

The little that Professor Fontaine has to say of the relations of the Virginia beds to those of Maryland and farther north is important and shows that, although he had not studied the latter except in a general way in Maryland, he had nevertheless formed a tolerably accurate opinion as to their nature. On page 14 he says:

"It should be stated that there is reason to think that the extensive formation of clay and fine sand known in Maryland as the 'variegated clay formation,' or the 'iron-ore clays,' may belong to the same general epoch as the Potomac of Virginia, forming an upper member of the group of which the Virginia Potomac is the lower. The Virginia beds and those of Maryland cannot now be certainly separated by any sharp differences; hence, for the present, the Virginia strata must be regarded as Lower Potomac, and the Maryland formation as Upper Potomac." And, again, on page 142 he makes the following statement:

"On entering the District of Columbia two members of the Potomac formation may be recognized. The lower is that traced through Virginia, and this is the only member recognized in that State. From the predominance of sand and sandstone in this it may be called the sandy member. The other, or upper member is composed of sands and clays, mostly the latter, both being usually highly colored with tints due to oxide of iron. The clays greatly predominate. They have the colors arranged in irregular spots, patches, and seams, and on account of this they have been called by Mr. Philip Tyson and Professor Rogers the variegated clay group. This is the upper member of the Potomac described at Fort Washington.

"*The sandy lower member of the Potomac is visible at Washington and at several points between Washington and Baltimore, in the vicinity of the Baltimore and Ohio Railroad.* The farthest point north at which it has as yet been seen is Baltimore."

It is clear from this that Professor Fontaine believed that the Older Potomac existed in Maryland. I remember his saying to me at about the time that I began my

studies of the formation in that State that he thought the cycads came from the sandstone member, and he once took me to see what he regarded as a typical exposure, on the Patapsco, near Relay, of the basal arkose, identical with certain phases that it presents in Virginia. This observation has been abundantly verified.

In common, however, with the prevailing opinion at that date, which was shared by Mr. McGee and myself, he regarded the iron ore clays, so-called, as somewhat higher and as constituting an 'Upper Clay Member.' At that time no other fossils than cycads, silicified wood and lignite had been found in the iron ore belt. Within the last two years, however, Mr. Arthur Bibbins has demonstrated the occurrence of fossil plants representing a considerable variety, but chiefly consisting of ferns and conifers. He finds them not only in the iron ore deposits, but in the iron ore itself, and I have had the satisfaction, in company with him, of collecting a large number of these and also of examining the much larger collection which he has made. Although these collections have not yet been elaborated and fully determined, a simple glance at them would be sufficient to show that they represent a flora substantially identical with that of the basal Potomac in Virginia, as typified in the Fredericksburg deposits. At the same time that Mr. Hatcher collected the bones in these beds which were described by Professor Marsh, and which constitute the only paleontological evidence that he has thus far brought forward as to their age, he also obtained, in intimate association with the vertebrate remains, a large number of fossil cones, which belong to the genus Sequoia and were undoubtedly borne on the trees which have furnished the silicified wood. All this is simply confirmatory of the antiquity of the iron ores and of their substantial identity in age with the basal Potomac of Virginia.

Professor Fontaine's general conclusions as to the stratigraphical relations of the Potomac formation are of such value in connection with the views of Dr. Newberry, next to be considered, that they should be given somewhat *in extenso*. They are to be found on pages 143–147 of this Bulletin:

"The New Jersey beds, as is shown by their fossil plants, *are certainly considerably younger* than the Virginia member of the Potomac. So far as is yet known, the Amboy clay is not younger than the Cenomanian of Europe.

"So far, then, as can be determined by the stratigraphy, the Virginia Potomac is considerably older than the Cenomanian and *much younger than the Rhetic*. The evidence from the stratigraphy, so far as it goes, agrees well with that of the fossils found in the Potomac.

"*The Wealden formation is most probably not uppermost Jurassic, but the estuary and marsh equivalent of the oldest marine Neocomian.* What will be said therefore concerning the Neocomian will include the Wealden.

"The flora of the Potomac seems to have been an abundant one. It was rich in species of certain groups, but, as compared with modern floras, it was poor in types. A large amount of fossiliferous material was obtained from points located at intervals between James River and Baltimore. The fossils found will give a fair idea of the general character of the flora. This flora has been studied by me, and is described in Monograph XV of the United States Geological Survey. The comparison of these plants with those of known fossil floras shows somewhat complex relations.

"There is present in the Potomac flora a *Jurassic element* which is large in the very considerable number of *genera* that characterize that system. Some few of the *genera* begin as far back as the Rhetic. This element shows indications of decadence. The number of species of each genus is

very small; generally only one or two. Very few individuals of the species are met with, and they are usually local in occurrence. The species are nearly or quite all peculiar to the Potomac.

"There is an important *Wealden element* in the flora. Many *species* of Potomac plants *are identical with species found in the Wealden of Europe, and this is the oldest known fossil flora that gives any considerable number of plants identical with the Potomac species.* Some of these species of the European Wealden are abundant and widely diffused plants in the Potomac. But while the species common to the European Wealden and the Potomac are noteworthy, there is a still larger number of important species found in the Potomac which are so nearly allied to Wealden species that they are with difficulty distinguished from them. These, although regarded as new species peculiar to the Potomac, *are probably forms representing Wealden species,* being modified by differences of environment.

"The Jurassic and the Wealden elements combine to give a Jurassic or Mesozoic facies to the flora, and hence, so far as they go, give it a comparatively ancient character. The Jurassic or Mesozoic type of flora is, as is known, characterized by the overwhelming predominance of four elements, viz: Equiseta, ferns, cycads, and conifers, and by the absence of angiosperms.*

"*The formations which possess the largest number of species identical with those of the Potomac are those of the Middle Neocomian or Urgonian.* The strata of this age which occur in Greenland (in Kome and other localities) and the Wernsdorf beds of the northern Carpathians yield an Urgonian flora, which Heer and Schenk have described. *In the plants coming from these regions we find the largest number of forms identical with Potomac species.* The number of Potomac species nearly allied to Urgonian forms is still larger. These identical and nearly allied species include many of the most characteristic, abundant, and widely diffused species of the Potomac. If we are to determine the age by the largest number of important species identical with those of known fossil floras, then *we would without hesitation set it down as ranging from the Lower through the Middle Neocomian.* A very large and important element of the Potomac flora is peculiar to this series. In this we find without doubt the most abundant, characteristic, and widely diffused species. As these are new, they can not give any direct evidence concerning the age of the formation, but indirectly the existence of such a large proportion of peculiar forms is favorable to the assumption that the age is Neocomian. The flora of this formation is one of the least known, and any large collection of richly fossiliferous material from beds of Neocomian age could not fail to furnish a great number of new species.

"Then again, the relatively great development of the conifers, along with the existence of an important cycadaceous element, *points strongly to the Neocomian as the era of the formation.* The survival of a considerable Jurassic element in the flora also indicates that it can hardly be younger than Neocomian. While much the most important elements of the flora indicate an age not more recent than the Urgonian or Middle Neocomian, there are some species which point to a more recent era of deposition for the formation. There are one or two species which are probably identical with forms found by Heer in the Cenomanian beds of Greenland. These are local and are represented by very few individuals. A few of the species also may be considered as nearly allied to some

* Both Professor Fontaine and Dr. Newberry use the old botanical classification which made the 'Angiosperms' synonymous with the Dicotyledons. It amounts to about the same thing here, however, on account of the almost complete absence of Monocotyledons in these floras.

occurring in the Greenland Cenomanian. These Cenomanian types are probably to be regarded as precursors not yet fully established, just as the Jurassic types must be considered as survivors not yet extinct.

"*The angiosperm plants present in the flora are much more important in giving a more recent facies to the flora.* They show quite a large number of species, but these are almost always local in occurrence, and are represented in most instances by few individuals. In a number of cases only one or two specimens were found. *It has been generally held that any considerable development of angiosperms in a fossil flora is strong, indeed conclusive, evidence that its age is not greater than that of the Cenomanian.* But apart from the evidence given by the older and predominant elements of the flora, there is reason to think that the Potomac flora is older than Cenomanian, even if we take into consideration the angiosperms alone.

"The conclusion above mentioned is based solely upon the fact that *in no flora older than Cenomanian has any considerable angiosperm element been found up to the present time*, but various writers have with justice maintained that it is improbable that the apparently sudden appearance of angiosperms in great force in the Cenomanian represents the true state of the case. It is highly probable that they had numerous precursors and ancestors, which existed in the Neocomian, and perhaps some of them, at least, in the Jurassic. It is probable that some of the forms called Protorhipis are ancient angiosperms. The existence then of numerous angiosperms in a flora which is predominantly Neocomian, but which contains many surviving Jurassic types, is just what we would expect to find. But we have direct evidence of the existence of angiosperms in the Neocomian. Heer has described from the Kome beds of Greenland, which are Urgonian in age, an angiosperm which he called *Populus primæva.* Only a few specimens were found. This single occurrence has remained so long unsupported by other discoveries of angiosperms in the Neocomian that doubts have been expressed concerning the correct localization of these specimens. It was thought possible that they really came from a younger flora. If the Potomac flora is in fact Neocomian, we have in this case a noteworthy illustration of the truth that positive evidence, however scanty, should outweigh any amount of negative evidence.

"The Potomac angiosperms in their general character give evidence of an age greater than Cenomanian. It is true that we find in them genera, and possibly some species, that survive into the Cenomanian and even down to the present time, but taken as a whole they form a peculiar group, *totally unlike the floras of the Dakota and the Amboy beds.* It is in the flora of the Dakota group, and the Amboy clays of New Jersey, especially the latter, that we would expect to find the greatest number of plants identical with Potomac forms. *Both of these floras are Cenomanian probably, and the Amboy flora, so far as yet known, is the one that comes next above the Potomac.* There are one or two species that are probably common to the Potomac and the Dakota beds, or that are nearly allied, but they are long-lived types, that come down to the present time with little modification.

"By the kindness of Dr. J. S. Newberry, who studied and described the New Jersey Amboy flora, I have been enabled to examine a large number of drawings of the New Jersey plants. *These plants are totally different from those of the Potomac. It is not certain that a single species survives from the Potomac into the Amboy beds. What is even more significant, even the genera that are most abundant in the Potomac and most characteristic of that formation have no representative in the New Jersey flora. It is clear that a very important gap exists between these two floras, and that an interval of time separates them, in which*

changes took place that produced an extensive destruction of vegetal types and altered the entire character of the flora.

"The localization of the species of Potomac angiosperms and their slight development, as shown in the very few individuals that in most cases represent them, indicate that these forms are, comparatively speaking, newcomers and precursors or ancestors of forms destined to become the predominant ones. This indication is confirmed by the character of a number of the species. They appear to be complex or comprehensive types, uniting in one form features that in the process of differentiation will later distinguish separate species.

"We may then conclude that the Potomac flora is not exactly like any known, *but on the whole coincides most nearly with that of the Lower and Middle Neocomian.* If this be true, then, we find that in this flora the development of angiosperms in considerable numbers has been pushed back through a long period of time."

In view of the fact that Professor Marsh, Mr. Gilbert and, to some extent, also Mr. Hill, in discussing the age of the Potomac formation, have referred to it as representing one definite epoch in the geological history of the Atlantic border, it does not seem superfluous to emphasize to any extent the fact which I have so prominently brought forward in my paper on The Potomac Formation,* and to which I also called attention in my own contribution to this discussion,† that the Potomac formation, as I have defined it and as also defined by Professor Marsh, including, as it does, the Older Potomac beds of Virginia, the iron ore belt, the purple clays, the white sands and white rocks (Albirupean of Uhler, Magothy of Darton), the Raritan and Amboy Clays of New Jersey, and the red micaceous-clay shales of Staten Island, Long Island and Block Island, as well as the variegated clays of Gay Head on Marthas Vineyard, represents a prolonged period in the geological history of the Coastal Plain equal to the entire Lower Cretaceous of Europe, *i. e.*, from the Wealden to the Gault of England, or from the lowest Neocomian to the highest Albian (Vraconnian)* deposits of the Continent.

With this fact in mind we are prepared to consider the still more startling statements contained in Dr. Newberry's Flora of the Amboy Clays. And first it will be necessary to determine precisely what Dr. Newberry meant by the Amboy Clays. This is made sufficiently clear by the following description (pp. 21–22):

"The Amboy Clays, to which our attention is now more particularly directed, outcrop in a belt extending diagonally across the State, forming the east bank of the Delaware River for a long distance above and below Philadelphia, leaving the Delaware at Trenton and stretching across the State at its narrowest point to Raritan Bay, and thence, passing over the southern portion of Staten Island, where, as in the State of New Jersey, they are largely worked for economic purposes. They are then interrupted by the Narrows and New York harbor, as well as by the crystalline rocks which occupy New York Island and underlie the northern portion of Brooklyn and the adjacent shores of Hell Gate. Eastward of this the Amboy Clays are generally covered with drift, but they appear at Glen Cove, Sea Cliff, and various other points on the north shore of Long Island, where it has been deeply cut into by glacial action and is now occupied by inlets from Long Island Sound. Possibly the whole length of Long Island is underlain by the Amboy Clays, as characteristic fossils

* Fifteenth Ann. Rept. U. S. Geological Survey, pp. 307–397, Washington, 1895.

† SCIENCE, N. S., Vol. IV., No. 99, Nov. 20, 1896, p. 757.

* See 16th Ann. Rept. U. S. Geol. Surv., p. 533.

have been found in the moraine on the extreme end of Montauk Point. Farther east, the clay series reappears on Marthas Vineyard and forms part of the noted cliff of Gay Head."

It is therefore clear that he includes in his Amboy Clays all the deposits north of the Delaware River, and that so far as these deposits are concerned they are the same as those to which Professor Marsh has referred in this section of the belt. As regards points farther south he has also made himself tolerably clear by the following language (p. 22):

"The southern extension of the formation has not been definitely traced, but it apparently thins out southward, appearing as an insignificant element in the series in Cecil county, Md., where Professor Uhler has described it as the bed of 'alternate sands and clays' which there rests on the Potomac and is overlain by the equivalents of the Cretaceous marl beds of New Jersey. South of this point it has not been recognized."

That Dr. Newberry found no close relations between the Amboy Clays and the Trias is also evident from the summary manner in which he dismisses this whole subject (p. 22):

"In New Jersey the Amboy Clay series is generally underlain by the Triassic red sandstones, which have been proved to be of the age of the Keuper or Upper Trias in Europe."

As to the real age of the Amboy Clays his opinions are so important that they need to be stated in full. After referring to the animal remains, in which he makes use of the same data as were employed by Professor Marsh, viz., the report of Professor R. P. Whitfield, he says (pp. 22–23):

"This evidence shows that the New Jersey clays occupy a position lower than the European chalk and higher than the upper member of the Trias. *Such other evidence as can be gained in regard to their precise geological age must be derived from their abundant plant remains*, among which are a number of species that are common to the Dakota sandstones of the interior of the continent, to the Atane and Patoot beds of Greenland —known to be Upper Cretaceous—to the Cretaceous clays of Aachen, Germany, and to the Upper Cretaceous rocks of Bohemia."

Turning then to the Older Potomac he discusses its relations to the Amboy Clays as follows (p. 23):

"The relation of the Amboy Clays to the Potomac formation of Virginia is not easily demonstrated, as the line of junction has not been fully traced, but we may say that the Potomac is the more ancient formation, and that probably *a somewhat long interval of time separated the epoch of the Potomac group from that of the Amboy Clays*. This is indicated by the *almost entire distinctness of the floras of the two formations*, which shows that *a great change took place during that interval in the character of the vegetation* which clothed the eastern shore of North America. Professor Fontaine has described, from the Potomac group of Virginia and Maryland, *365 species of plants, of which not one is certainly found in the Amboy Clays;* and the difference in the character of the vegetation is shown by the fact that in the long list furnished by Professor Fontaine *there are but 75 angiosperms* (about one-fifth of all), whereas in the New Jersey clays, throwing out fragmentary and doubtful remains, *of 156 described species all but 10 are dicotyledonous plants.*"

Having thus disposed of the possibility of the Potomac formation in Virginia being of the same age as the Amboy Clays, and having demonstrated its much greater antiquity, he sets about to discover the true geological affinities of the Amboy Clays. His conclusions may best be given in his own words (pp. 23–24):

"The relation of the Amboy Clays to the

Dakota group can be much more definitely determined, for the proportion between the angiosperms and the lower plants in the Dakota group is about the same as in theAmboy Clays, showing a similar stage of progress in the development of plant life. We have already obtained 12 species common to the two formations, a number that will undoubtedly be considerably augmented with the further exploitation of the Amboy flora. *The Dakota group is known to occupy about the middle of the Cretaceous system.* Until recently it was supposed to be the basal member of that system as developed on the North American continent, and it was believed that until about the middle of the Cretaceous period our continent had remained above the ocean level; but *it has been shown recently that considerable areas of North America are occupied by sediments deposited from the Cretaceous sea before the date of the Dakota formation,* and that on the northwestern coast, on Queen Charlotte Island, and in the Shasta group in California we have accumulations of sediment that *took place before the Dakota sandstones.* Mr. R. T. Hill and Dr. C. A. White have demonstrated that a considerable portion of the State of Texas is underlain by rocks that are the *equivalent of the Neocomian or Lower Cretaceous of the Old World.* Very recently, too, Sir William Dawson has found in the fresh-water coal-bearing deposits of western Canada fossil plants identical with some from the Kome group or Lower Cretaceous of Greenland; and a much larger collection of fossil plants obtained by the writer from the coal basin of the Falls of the Missouri in Montana, collected by Mr. R. S. Williams, contains many Kootanie or Lower Cretaceous plants, and, what is of still greater interest, a number of species that have been described by Professor Fontaine from the Potomac group of Virginia. *Thus the conclusions of Professor Fontaine as to the Wealden age of the Potomac are strikingly confirmed.* His arguments in favor of this view were that the Potomac flora was most like that of the Wealden of Europe, a few of the species being apparently identical, while it had nothing in common with any other flora known. *To this I ventured to add the suggestion that it could hardly be Jurassic,* as claimed by some writers, *since in no part of the world had angiosperm plants been found in the Jurassic, though in Europe the Jurassic rocks had yielded great numbers of plants and the flora had been carefully studied.* Now the finding of species identical with those of the Potomac in the Great Falls basin, and with them plants found in the Kootanie of Canada and the Kome deposits of Greenland, seems to place the question beyond doubt."

He was struck by the fact that several species were identical with those long ago discovered at Aachen by Dr. Debey, occurring in a formation whose geological position is known to be Upper Cretaceous, and he took the trouble to visit that locality and examine Debey's collections, a considerable number of which he purchased and brought to America. After carefully comparing these with those of the Amboy Clays, and in the light of an extensive acquaintance with other similar floras, he concludes the introductory part of his work with the following general statement (p. 33):

"The mode of accumulation of the beds at Aachen seems to have been similar to that of the Amboy Clays and the Potomac group; that is, they are local estuarine beds resting upon the Paleozoic rocks and composed of the wash of the neighboring land, in which were buried great numbers of leaves and trunks of the trees which grew upon that land. The trunks are now converted into lignite, and they are as conspicuous an element in the lithology of the group as in New Jersey. Dr. Debey supposed that his collection contained 300 to 400 species of angiosperm plants. This is perhaps an exaggeration, for he included in

his list a great many doubtful fragments; but when the floras of the Aachen beds and those of the clays of New Jersey shall be fully studied and illustrated it will undoubtedly be found that the botanical aspects are the same, and that there are perhaps as many species identical in the two formations as in those of Greenland and New Jersey. Hence, *we may fairly infer that the collections of plants from the New Jersey clays, the Dakota group, the Patoot and Atane beds of Greenland, the Aachen series of Germany, and the plant-bearing Cretaceous rocks of Bohemia fairly represent the vegetation of the world during the middle and latter portions of the Cretaceous age.*"

I do not wish to conceal the fact that Dr. Newberry's views are somewhat extreme in the direction of raising the Amboy Clays up to a level with the Dakota group of the West and the Aachen and Atane beds. My own explanation has always been that the Greenland beds are simply the northeastern extension of the Amboy Clays and Island Series, but that they may nevertheless represent a somewhat higher horizon in the same way that the Amboy Clays are higher than the Older Potomac of Maryland and Virginia, although belonging to the same general belt, either through the destruction of the lower members of the formation or because the continent at those points was out of water while the Virginia beds were in process of deposition. On this theory it would be perfectly natural that a large number of Amboy Clay species should have survived with little change into the slightly more modern period at which the Atane beds were deposited. In confirmation of this, and against the view of the great similarity between the Amboy Clay flora and that of the Dakota group, I have shown that most of the species common to the two are such as Professor Lesquereux, in studying the Dakota group, identified with Greenland forms, and I have also shown that, in a few cases at least, such identifications were not justified.* I therefore still think that the Amboy Clays, including the Island Series, are lower than Cenomanian, but any attempt to place them below the extreme summit of the Lower Cretaceous would, in the light of these facts, involve assumptions too violent to be entertained.

It certainly cannot be justly said that all this evidence, because derived from fossil plants, is without value. The floras, both of the Older and Newer Potomac, are altogether too rich and too definite to be disregarded. Taken as a whole they show as well marked differences in the character of the vegetation as could be desired. It is true that geologists and paleozoologists are generally unprepared to weigh the evidence from fossil plants, but in this case they need not know the specific nature of the plants. It is sufficient to compare the illustrations, say, of The Flora of the Amboy Clays, with those of The Potomac or Younger Mesozoic Flora.† They may be regarded simply as pictures, and it requires no practiced eye to discover that they are utterly unlike. A child would readily perceive the difference between a plate illustrating the ferns, cycads, and conifers of the Older Potomac and one illustrating the broad dicotyledonous leaves of the Amboy Clays. The contrast would be still greater if made with any of the true Jurassic floras of the world, as, for example, that of France, so profusely illustrated by the late Marquis Saporta in eight volumes containing 300 plates.‡ It therefore seems to me that the two works now before us, together with the early illustrated one of Professor Fontaine, furnish

* The Potomac Formation. 15th Ann. Rept. U. S. Geological Survey, pp. 373–374.

† Monographs of the U. S. Geological Survey, Vol. XV., plates.

‡ Paléontologie française. Végétaux. Terrain Jurassique, par le Marquis de Saporta, 4 vols. each of text and atlas, Paris, 1873–1891.

the most complete demonstration that could be made of the essential difference between the Older and the Newer Potomac, and all the proof that should be necessary to establish my fundamental thesis that, while the former must lie very near the base of the Lower Cretaceous and may even extend somewhat into the Upper Jurassic, the latter must be correlated with the extreme Upper members in the European series of Lower Cretaceous deposits.

So far as I am concerned, I have no interest whatever in the mere question of names, for example, as to whether the Wealden should be called Cretaceous or Jurassic, and I have done what I could to show that the Older Potomac was laid down under conditions very similar to those of the Wealden of England and that, in all probability, the process of deposition of portions of both at least was going on at the same time. If Professor Marsh, throughout his papers, had substituted the term Wealden for 'Jurassic' it is doubtful whether they would have given rise to any discussion, so far as the Maryland beds containing the vertebrate remains are concerned. But he has chosen to employ the term Jurassic without qualification, and there are indications that he does not mean to correlate the Potomac formation with the Wealden, but regards portions of it at least as Oolite. In his last paper* he says: "It cannot, of course, be positively asserted at present that the entire series now known as Potomac is all Jurassic, or represents the whole Jurassic. The Lias appears to be wanting, and some of the upper strata may possibly prove to belong to the Dakota." This would give the Potomac formation an enormous extension, viz., from the base of the Oolite to the Upper Cretaceous. The less than twelve hundred feet that it has been possible thus far to measure in the Potomac formation* would seem to be an exceedingly thin stratum to represent such a period, even after allowing for any amount of contemporary erosion.

Professor Marsh says that it is a reproach to science that the Jurassic has not been discovered in the eastern part of the continent. This may be true, provided it exists, but if it does not exist the finding of it would be a still greater reproach to science. His section would seem to indicate that he regards the Dakota group as forming the lowest member of the Cretaceous. This has never been maintained by any geologist. It is true that it was claimed for many years that it represented the lowest Cretaceous in America, but those who made this claim assumed the absence of the Lower Cretaceous in any part of this country. Professor Marsh's assumption, if that is what he means,† would carry with it some peculiar consequences; it would make the beds that are now known to underlie the Dakota group (the Comanche series, the Kootanie, the Shasta group, and the Queen Charlotte Island group, as well as the Potomac formation) all Jurassic. A number of these, especially those of Texas and the Pacific coast, are marine deposits and contain abundant invertebrate remains, fully establishing their Lower Cretaceous age. But

*Amer. Journ. Sci., 4th Ser., Vol. II., December, 1896, p. 436.

*15th Ann. Rept. U. S. Geol. Surv., p. 339.

†Since this was written I have had an interview with Professor Marsh and was glad to learn that he disclaims such an interpretation of his section. He maintains that the explanation on p. 144 of the 16th Annual Report United States Geological Survey was intended to prevent this impression from being gained and called my attention to the following words, and especially to those in italics: "This diagram represents the principal geological horizons *of vertebrate fossils* in North America, *as determined by the writer.*" To have justified such an interpretation his diagram should have embraced no formations from which vertebrate fossils had not been determined by him. A glance at the diagram, however, shows that there are two groups opposite which he has indicated no vertebrate remains, and one of these unfortunately is the Dakota group.

this is not all. The Shasta group, at least, is directly underlain by true Jurassic beds. It is altogether improbable that those who have established the age of these deposits from what is admitted to be the very best paleontological evidence will abandon this determination and adopt that of Professor Marsh.

When I made my slight contribution to this discussion* only Professor Marsh's two papers on the 'Geology of Block Island' had appeared, in which the evidence to establish his position was promised in the future. From the confident manner in which he spoke in those papers all expected that his next paper would contain an account of the discovery of Dinosaurs and other vertebrate remains on Block Island, Long Island, Staten Island, and Marthas Vineyard. His much fuller paper in the December number of the *American Journal of Science* is disappointing in not furnishing this evidence. Every one, I believe, would welcome any facts bearing on the subject, and all are equally interested in considering all possible data. His failure to present such evidence in this paper leads some skeptical people to suppose that it does not exist. Speaking of Gay Head, he says (p. 437): "The striking resemblance between the variegated cliffs at Gay Head, the Potomac hills in Maryland, and Como bluffs in Wyoming, will impress everyone who has seen them. That all three are of essentially the same geological age, I have good reason to believe. Two of them are certainly Jurassic, as demonstrated by typical vertebrate fossils, and *I hope soon to prove* that Gay Head, so similar in all other respects, also contains the same characteristic vertebrate fauna that marks the Jurassic,—the long missing formation on the Atlantic coast."

It would have been much better if he had actually proved this. It is always unsafe in geology to predict what we shall prove; such sweeping generalizations as Professor Marsh makes are very hazardous. To stand on Block Island and correlate its formation with that of Como bluffs in Wyoming is not the modern method of geological investigation. As he says: "The Gay Head Indians are not hostile." I did not find them so, neither did Mr. White when he made his large collection of fossil plants there. They would probably not harm a vertebrate paleontologist any more than a paleobotanist, and I submit that there is a better way of geologizing than to sit at one's 'study window' at New Haven and 'look across the Sound to Long Island.'

It is still fashionable to disparage the evidence from fossil plants, and Professor Marsh's papers would have been incomplete without the usual amount of this kind of matter. This is not the place to enter into a defense of fossil plants or to point out their value to geology. I have attempted to do this on former occasions.* I only desire here to refer to the two authors whose works I have considered as among those who do not take this view. Professor Marsh has followed most other writers in digging up the errors of the early paleobotanists while ignoring the work of the later ones, but I am surprised that he should have adopted the view which resulted from these errors, and which has long been exploded, that there is any lack of harmony between the evidence which plants afford and that of other forms of extinct life. Dr. Newberry was one of the first to correct this error and to insist that when all the evidence from plants and animals should be in there would

*Science, N. S., Vol. IV., Nov. 20, 1896, p. 757.

*Principles and Methods of Geologic Correlation by Means of Fossil Plants. American Geologist, Vol. IX., pp. 34–47; Principes et méthodes d'etude de corrélation géologique au moyen des plantes fossiles, Compte-rendu de la cinquième session du Congrès géologique international, Washington, 1891, pp. 97–109. Cf. also: Fossil Plants as an aid to Geology, by F. H. Knowlton, Journal of Geology, Vol. II., pp. 365–382.

be no lack of correspondence in their teachings. This truth is now receiving a signal confirmation by the discovery of fossil plants in marine shell-bearing deposits, especially in the Lower Cretaceous of Portugal, of Texas, and of California. Neither is the 'botanical time piece' either too slow or too fast, and the organic pendulum has always swung in perfect unison on both sides of the Atlantic. LESTER F. WARD.

WASHINGTON, D. C.

*THE AMERICAN MORPHOLOGICAL SOCIETY.**

The Rôle of Water in Growth. C. B. DAVENPORT.

In developing tadpoles of various amphibia the amount of water contained was determined at short intervals between the time of hatching and midsummer. These determinations showed that during the first week or two of development the amount of dry substance in the embryo remains nearly absolutely the same as it is in the just-hatched larva, where it constitutes little less than half of the whole weight. During this period the immense increment in weight which accompanies the outlining of the form of the larva and its organs is due almost solely to imbibed water. It is the specific imbibition of water then which determines the direction of differential growth in the developing tadpole. As in plants this 'grand period of growth' is followed by one of histological differentiation, during which the absolute (and relative) quantity of dry substance increases rapidly.

The Structure and Function of the Midgut in Terrestrial Isopods. J. P. MCMURRICH.

The general result of the study of the Isopod midgut may be summed up as follows:

1. The so-called 'midgut' of the terrestrial Isopods is of ectodermal origin and is in reality a portion of the proctodæum.

2. It is lined by an impervious layer of chitin.

3. The cells which compose it possess no definite boundaries and form an epithelial syncytium.

4. The fibrils which traverse the cells from the basement membrane to the layer of chibin are, throughout the greater part of their extent, of the same material as the basement membrane, their central ends, however, being apparently chitinous. They are not protoplasmic, as Ide has maintained.

5. The nuclei frequently show great irregularities of form; these irregularities are sometimes due to injury, but in other cases appear to be normal and to indicate a power of amœboid movement.

6. The conjugation of the nuclei, described by Ryder and Pennington, does not occur.

7. Fragmentation of the nuclei occurs as a degenerative change, but amitosis for growth or regeneration, if occuring at all, is infrequent.

8. The increase in size of the 'midgut' appears to be due not to an increase of the *number*, but to an increase of the *size*, of the cells present at the close of embryonic life.

9. Feeding experiments indicate that the midgut does not possess an absorptive function; it merely serves for the passage of undigested material to the exterior.

A paper giving in detail the evidence on which these conclusions are based is in the hands of the editor of *The Journal of Morphology.*

The Result of the Suspension of Natural Selection as Illustrated by the Introduced English Sparrow. H. C. BUMPUS.

Over 1,700 eggs were critically examined, and 'curves of frequency' were drawn to illustrate the differences between the European and American specimens. It was found that the American eggs presented a much greater amplitude of variation than the European, that they were smaller and that they were of a strikingly different shape.

*Concluded from page 392.

The bearing of these facts upon the current theories of degeneration, panmixia, etc., were indicated.

The American eggs ranged in length from 18 mm. to 26 mm., while the shortest and longest European eggs measured respectively 18.5 mm. and 25 mm. The typical American eggs, moreover, had an average length of approximately 21 mm., while the European eggs averaged at least 1 mm. longer.

The ratio of breadth to length, *i. e.*, the ratio of the lesser to the greater diameter, showed much greater sphericity on the part of the American eggs, though also in respect to this feature the American eggs presented a much greater amplitude of variation.

The extremes of variation in shape and color were determined by a process of 'disinterested selection.' After having placed a secret mark upon each American egg, the eggs of both countries (863 American and 863 British) were thoroughly mixed together in a single tray. A disinterested person was then requested to select from the mixture 100 eggs that appeared to him to present extremes of shape variation. If eggs from the two countries were equally variable, of course approximately the same number from each would be selected, and if the American specimens were more variable, more American eggs would be selected. The result was in harmony with the evidence derived from the comparison of length and the ratios of breadth to length. Of the selected eggs, eighty-one were American and only nineteen were English, over four times as many of the former as of the latter.

The same method was adopted for the determination of color variation and with the result that eighty-two of the examples of extreme color variation were found to be American and only eighteen British. It was pointed out that this large proportion of extreme color variation on the part of American eggs was not only interesting in itself, but that when the figures are compared with those representing extreme variation in *shape* the significance of both results is enhanced. Not only is the preponderance of variation among American eggs very obvious, but in both cases, in shape and in color, it is almost precisely the same.

It was concluded that the data, whether gathered from comparisons of length, ratio of breadth to length, shape or color, all point in the direction of a general structural modification.

On the Plankton of Brackish Water. G. W. Field.

Investigations of the Plankton are now being carried on at the Marine Laboratory of the Rhode Island Experiment Station at the Great Salt Pond, near Point Judith, in South Kingston, R. I. It is intended to continue the observations, both summer and winter, for a term of years.

The pond is about five miles long and comparatively narrow. Its area is estimated at 1,500 acres. At the northern end, where the river enters, the water at the surface is quite fresh (specific gravity 1.000); at the bottom it is slightly saline (specific gravity 1.0055). The south end communicates with the sea. The specific gravity of the water at the outlet is 1.025. At points between the north and south ends of the pond are found all intermediate degrees of salinity.

Examination of the number of organisms per litre shows that the number is greatest in those areas where the specific gravity is between 1.008 and 1.020 (*i. e.*, the middle portion of the pond), and that in passing in either direction, southerly towards the ocean, or northerly towards the river, the number diminishes.

The most important constituents of the Plankton, named in order of the number of individuals, are: diatoms and algal débris;

ciliated infusoria; arthropods; (copepods, amphipods; ostracods; decapod larvæ and larval tracheata); rotifers; annelid larvæ; ctenophores; medusæ. In its general character it more closely resembles Haliplankton than Limnoplankton, the marked exceptions being the presence of rotifers and the absence of cladocera.

It has been frequently observed and recorded that copepods come to the surface in vast numbers at night. We have frequently observed that on certain days they are at the surface in equal abundance. Their presence at the surface appears to be independent of light and darkness, or of meteorological conditions, but correlated with the presence at the surface of certain species of diatoms, or of quantities of algal débris; observations confirming the belief that these diatoms and amorphous organic materials are the principal food of copepods and of young decapod larvæ.

Rotifers occur in great abundance during July, August and September, but we have found them at the surface only during the day, and near the bottom during the night.

Cordylophora and a nudibranch mollusc are found in water whose specific gravity never rises above 1.005.

Investigations are now in progress to discover the cause of the phenomena noted by us, that ctenophores and medusæ (*Dactylometra*), which are brought into the pond by the tide, are checked in their growth, and after several months of residence in the pond show but a very slight increase in size. The same causes have possibly resulted in the various species of *Nereis Balanus*, and molluscs described as inhabiting only brackish water, and which differ from similar marine species mainly in their smaller size.

Our earlier methods of plankton collection were by means of fine nets, and by sand filtration of known volumes of water after the method of Henson, Reighard, Sedgwick-Rafter, Peck and others, but these have been superseded by use of the *Planktonokrit*, invented and described by Dr. C. S. Dolley.* The centrifugal method is a distinct advance, and materially reduces the error when dealing with all organisms thus far met with, except the Cyanophyceæ. But with steam power it is confidently expected that enough centrifugal force can be developed to throw out even these.

The machine is particularly valuable as a rapid, sure method for collecting the microscopic plankton, and its use will disclose many forms hitherto rare or unknown. As used by us, the two reservoirs, each of one litre capacity, are filled with water drawn from a known depth by means of a valved tin tube. For control purposes both reservoirs are used. After revolving 2 to 5 minutes the volume of organic matter is read on the graduated tube; the tubes are then unscrewed, and the contents washed out by a pipette and filtered distilled water into a tube of narrow lumen graduated to $\frac{1}{100}$ of a cc. After settling for the necessary time, either with or without treatment with Formalin, the volume is read and compared with the volume noted upon the graduated tube of the reservoir. This is necessary from the fact that certain forms are packed more closely than are others by the centrifugal force. The volume of water is then made 5 cc.; the organisms are distributed evenly by gentle shaking or by a pipette, and the number of individuals of each species is enumerated according to the Sedgwick-Rafter method.

Nocturnal Protective Coloration of Mammals, Birds, Fishes and Insects. A. E. VERRILL.

Much has been written in respect to the imitative and and protective colors of mammals, birds, insects, etc., and the bearing of these facts on natural selection, to which

*Proc. Acad. of Nat. Sci. Philadelphia, May, 1896.

they are unquestionably due, is well known. Nearly all the cases cited by authors relate to colors as seen by daylight. I wish to call attention to the importance of studying the forms and colors of animals with reference to their appearance and protective value as seen by moonlight, starlight and in the dusk of early morning or the twilight of evening, when vast numbers of insects, birds, small mammals, etc., are most in need of protection against their predacious enemies, which generally hunt their prey at such times. The danger to most birds and to diurnal insects is due to their sleeping more or less exposed to view, but the danger to most of the smaller mammals and nocturnal insects, fishes, etc., is due to the fact that they are most active at night or in the twilight, and therefore more easily observed by their enemies. Moreover, the predacious species need protective or imitative colors at night, in order to approach their prey unobserved.

Moonlight and skylight give very black shadows in which dark brown, dark gray and black animals are nearly or quite invisible. Black shadows of foliage are apt to be broken up by patches of white moonlight. Therefore patches of white or light yellow on dark or black animals are imitative of such moonlight effects, and as they serve to break up the dark outlines of beast or bird, they are very effective as a protection at night.

Thus we find among nocturnal carnivores many instances of black colors, as the mink, fisher, bear, etc., and of black and white ones, as the skunk, badger, etc. So among the small species preyed upon, there are numerous birds that are black, black and white, black and yellow, etc. All such strongly contrasted colors are more likely to be of value for protection at night than in the daytime. This also applies to the butterflies and other bright colored diurnal insects whose colors often have no obvious relation to their diurnal surroundings, but blend with the colors of the flowers or foliage on which they roost at night. Many of our large red and brown butterflies of the genus *Argynnis*, etc., have bright silvery spots on the under side of the wings, so that they are conspicuous objects in the daytime. But I have observed them at roost on the golden-rods and other favorite flowers by moonlight, when the colors of their folded wings blend well with those of the flowers, and their silvery spots glisten like the dewdrops around them. Thus their conspicuous markings become protective at night.

A great number of field mice, shrews, moles, etc., have dark gray or grayish brown colors, more or less like the common rat and mouse. Such animals are nocturnal in their habits, usually hiding in holes by day. Their colors are not protective in the daylight amongst green herbage, but at night they are eminently so, for they are almost invisible in green grass, if quiet, as I have often observed, even in good moonlight. Animals that live among the stalks of reeds or shrubs may gain protection by having conspicuous dark stripes. No doubt the tiger is better concealed by his stripes, while in his native haunts, in the night than in the daytime. The same is true of the leopard and jaguar, and perhaps of the zebra. Many fishes that rest at night among eel grass and sea weeds have conspicuous transverse or longitudinal black stripes; which are highly protective in a dim light, for they look like the dark stems and shadows of the weeds, and serve to break up or conceal the outline of the fish. Black tails and fins serve the same purpose. Such markings of fishes are often more conspicuous at night than in the daytime. All the cases referred to above seem to be the direct results of long-continued natural selection.

Nocturnal and diurnal changes in the color of certain fishes, with notes on their sleeping habits. A. E. VERRILL.

While investigating the nocturnal habits of fishes, etc., in the aquaria of the laboratory of the U. S. Fish Commission, at Wood's Holl, in 1885 to 1887, I unexpectedly discovered that many species of fishes, and also the common squid (*Loligo Pealei*) take on special colors at night, while asleep, or at rest, in a feeble light. These observations have not hitherto been published, because I hoped to have had opportunities to continue them and make them more complete. It is now my hope that others, with better opportunities, may take up the subject. My observations were made after midnight, when everything was quiet, for fishes sleep very lightly. The gas jets near the aquaria were turned down as low as consistent with distinct vision, and great care was taken not to jar the floor or furniture. With these precautions I was able to detect many species in the act of sleeping. Some of them took unexpected positions when asleep.

The most common change in colors of the sleeping fishes consisted in a general darkening of the dark spots, stripes or other markings, by which they become more distinct and definite. This was the case with various flounders, minnows (*Fundulus*), the black sea-bass (*Serranus furvus*), the sea-robins (*Prionotus evolans* and *P. palmipes*), the king-fish (*Menticirrus nebulosus*) and several other species.

In all these cases the change of color is in the direction of increased protective coloration, the dark markings being generally connected with their habits of resting naturally at night among eel-grass and sea weeds. The young fishes often showed greater changes than the adults.

Other species showed a much greater change in color, for the pattern of coloration was itself entirely changed. Thus the common scup, or porgy (*Stenotomus chrysops*), while active in the daytime, is of a beautiful silvery color with bright, pearly, iridescent hues. But when asleep it takes a dull bronzy tint and is crossed by about six conspicuous, transverse, black bands, a coloration well adapted for concealment among eel grass, etc. If awakened by suddenly turning up the gas, it almost instantly takes on its silvery color, seen in the daytime. This experiment was tried many times.

A common file-fish (*Monacanthus*), which is mottled with dark olive-green and brown in the daytime, when asleep becomes pallid gray or almost white, while the fins and tail become black. These are nocturnally protective colors. The file-fishes, when asleep, often lean up obliquely against the glass of the aquaria, with the belly resting upon the bottom in very queer positions. The tautog, or black fish (*Tautoga onitis*), commonly sleeps on one side, often partly buried in sand or gravel, or under the edges of stones, much after the fashion of flounders, thus suggesting the mode in which the flounders may have developed from symmetrical fishes in consequence of this mode of resting, becoming chronic as it were.

Notes on the Phylogeny of the Carnivora. W. B. SCOTT. (Read by title.)

The Peripheral Nervous System of Nereis Virens. F. E. LANGDON.

This study was made partly on material living and unstained; partly on that stained by methelene blue and examined either fresh or fixed by Bethe's method, and partly on that prepared by the more common methods.

The spindle-shaped sensory cells described by Retzius as isolated are really grouped into semi-organs which have a definite distribution over the body. Each organ consists of a fusiform group of cells whose bodies lie below the epidermis or in its base. The cuticular markings over the

organs in the appendages of the body are like those over the sense organs of Lumbricus. Over the body itself each cuticular marking is concave on the exterior and the very thick cuticula encloses beneath each marking an ovoid cavity through which pass the outer ends of the sensory cells. Each sensory cell usually bears several sensory hairs, and these hairs cannot be retracted normally as supposed by Retzius.

In the gill lobes of the parapodia, the base of the palps, the prostomium and several anterior metameres is found a second kind of sense organ, apparently a light-perceiving organ, not previously described.

In the center of each organ is a slender, flexible tube, open to the exterior and continuous with the cuticula. Around this tube the club-shaped peripheral ends of 100 or more bi- or multipolar nerve cells are arranged in a spiral of from 8 to 14 turns. The bodies of these cells are irregularly grouped in or beneath the base of the epidermis; the central nerve fibre passes to the central nervous system; the peripheral fibre is at first slender, but ends in the club-shaped enlargement mentioned above. The tip of this enlargement, and sometimes the entire enlargement itself, is filled with a clear, highly refractive, lens-like substance.

The central fibres from both diffuse and light-perceiving organs end in *apparent* nerve baskets around the ganglion cells of the central nervous system.

Beside the four eyes and the two pairs of sense organs of unknown function described by Retzius, the prostomium contains a third pair of organs near the anterior pair of Retzius. The groups of ganglion cells described by Retzius near the anterior eyes are not, as that author supposed probable, concerned with the innervation of the eyes; the preparations from which this study was made show plainly the nerve bundles passing from the eyes to the brain.

Epidermal Sense Organs in Certain Polychætes. Margaret Lewis.

The epidermal sense organs were studied in two members of the annelid family of the Maldaniæ, both by means of ordinary methods and by the use of methylin blue. The following are the chief conclusions:

1. That multicellular sense organs are present throughout the integument of the two polychæte annelids *Clymenella torquata* and *Clymene longa*.

2. That the cells of these sense organs are spindle-shaped, bipolar nerve cells.

3. That the individual cells making up a sense organ show great variation in the distance of the enlargement containing the nucleus from the cuticula. This enlargement may be close to the cuticula, at half the height of the epidermis or sunk to the base of the epidermis.

4. That the cells of the sense organs possess at their peripheral ends sensory hairs.

5. That from the deep end of each cell proceeds one process which turns at an angle beneath the epidermis toward the central nervous system.

6. That in many respects the sensory cells of these epidermal sense organs show a striking resemblance to the epidermal sense cells which Retzius describes for *Nereis;* the chief difference being that Retzius found only isolated sense cells in the epidermis of *Nereis*, whereas in these Maldanids these sense cells without exception are grouped into definite sense organs.

The Eyes of Limax maximus. A. P. Henchman.

The eye consists of six parts: (1) Optic ganglion, (2) Sclerotic capsule, (3) Retina, (4) Vitreous humor, (5) Lens, and (6) Corneal layer. The optic ganglion is a funnel-shaped enlargement of the optic nerve, containing oval nuclei. The sclerotic capsule is a thin, firm layer of connective tissue, containing at intervals oval

nuclei which are much flattened. The retina is composed of nerve fibres and a single cell layer embracing two kinds of cells: viz. (*a*) pigment cells and (*b*) sensory cells. In sections along the chief axis of the eye the retina presents three concentric zones; the innermost, of a pale yellowish color, is composed of the so-called cones; the middle is the pigment zone and exhibits higher radial bands alternating with broader masses of more opaque appearance; the outer zone, which is destitute of pigment contains, nuclei of two kinds: large, pale, circular ones, and smaller, elongated, deeply staining ones. The branches of the optic nerve constitute the outermost portion of this clear zone next to the sclerotic.

These three zones are really made up of a single layer of cells, the retinal cells, of which there are two kinds: the unpigmented, or sensory, and the pigmented. The pigment cells are club-shaped and contain granules of dark brown pigment. Their central ends all terminate at nearly the same level and rather abruptly. Their basal ends run out into long fibres which are often branched. The lighter radial bands of the middle zone are produced by the sensory cells. These extend nearer to the center of the eye than the pigment cells, each ending in a club-shaped portion that is rounded at its free extremity. This club-shaped prolongation is surrounded by a thick mantle of substance having a radially fibrous structure. These prolongations with their mantles constitute the 'cones.' The unpigmented, or sensory, cell itself shows throughout its whole course a longitudinally fibrous structure, contains no pigment and terminates at its deep end in a large number of fibrous branches.

The sensory and pigment cells are definitely grouped into sets. Each set, or ommatidium, comprises a single central sensory cell and a small number (5–7) of pigment cells surrounding it.

In front of the pigment cells of the antero-ventral margin of the chief eye its sclerotic capsule is somewhat enlarged so as to include a hitherto undescribed structure, which reproduces on a smaller scale almost exactly the conditions found in the chief eye. In one respect only does it differ from the chief eye; the cells corresponding to the pigment cells of the retina *contain no pigment granules*. In other respects it presents the same histological conditions and a similar arrangement of the histological elements. The innervation of this accessory retina is effected by nerve fibres from the optic nerve, which accompany those distributed to the antero-ventral portion of the chief eye. The cells composing the accessory eye are separated from the pigment cells of the adjacent parts of the chief eye by elongated cells with small oval nuclei. At the angle formed by the juxtaposition of the two retinas are seen several very large nuclei. Some of these are probably the nuclei of sensory cells, but there are others which are much larger than the nuclei of the sensory cells and do not seem to be connected with cells terminating in fibrous cones; they have a striking resemblance to the large ganglionic cells of the central nervous system. These are the largest nuclei found within the eye capsule.

The Optic Lobes of the Bee's Brain. F. C. KENYON.

In the optic lobes of the bee's brain there are, as in other hexapods, three masses of fibrillar substance surrounded more or less completely by masses of cells. The middle and inner masses or bodies may in section be recognized as composed of a pair of lenticular, densely and finely fibrillar bodies or capsules, fitted one within the other and with their convex surfaces directed outward, their concave surfaces inward. The capsules in each body are separated from one

another by a loose mass of fibres running parallel to the surfaces of the capsules.

In the middle body this middle layer of fibres is gathered into a bundle at the anterior margin of the body and passes out towards the central portion of the brain. Almost immediately the bundle divides. One division goes to the calices of the mushroom bodies, forming thus the antero-superior optic tract; the other to the lower posterior portion of the brain, forming the antero-posterior optic tract.

From the middle loose layer of fibres of the inner body several bundles arise, all penetrating the hinder portion of the brain. One bundle forms an upper, another a lower commissure between the two optic lobes.

The fibrillar elements from the retina terminate in five branches and thus help to form the outer mass of fibrillar substance. From cell bodies between the basement membrane of the retina and this mass fibres pass inward, give off short, fine fibrils connecting with the terminating fibrils just noted, and then go further inward, forming, with their fellows, the outer chiasma and terminate in a bunch of fibrils in the outer capsule of the middle body. These form neural elements 1. From cell bodies between the outer chiasma and the middle body fibres penetrate the outer capsule of the latter, giving off a bunch of lateral fibrils connecting with the terminals of elements No. 1. The main fibre then crosses the body to the inner capsule, gives off in it a group of short fibrils, then leaves the body, and after forming, with their fellows, the inner chiasma, finally terminate in the outer capsule of the inner body of the lobe.

From cell bodies between the margins of the two bodies neural elements No. 3 arise, that bear the same relations to the inner body and its capsules as do elements No. 2 to the middle body. Passing out of the concave surface of the inner body some of the elements are gathered into a bundle that passes forward, forming the anterior optic tract and terminate in the optic body, a small oval mass of fibrillar substance above the antennal lobe. Others go upward as a bundle of fibres to the calices of the mushroom bodies, forming thus the postero-superior optic tract.

The branching terminals of the fibres forming the antero-superior optic tract seem to connect with the lateral fibrils of element No. 2 in the inner capsule of the middle body, and the terminals of the fibres forming the posterior optic tracts connect similarly with the inner lateral fibrils of elements No. 3.

A stimulus to a retinal element may reach the central portion of the brain by passing over three or four neural elements and may reach either the mushroom bodies, the optic body or several portions of the posterior part of the brain, or passing over more elements it may reach all these regions, and even be transferred over the two optic commissures to the opposite lobe, and thus indirectly reach the mushroom bodies, the optic body or the posterior portion of the brain on the other side.

The earliest differentiation in the central nervous system of Vertebrates. A. Schaper.

The speaker presented briefly some of the results of his recent investigations on the histogenesis of the central nervous system which are to be published in extenso in the 'Archiv für Entwicklungsmechanik.' The essential points of this paper were the following:

1. The so-called '*Keimzellen*' of *His*, lying near the central cavity of the neural tube, along the membrana limitans interna, are not at all to be considered as a special type of cells in contrast to the main epithelial part of the medullary wall. They are nothing else than *epithelial cells in process of continuous proliferation* and serve in the earliest stage of develop-

ment only to increase the number of the epithelial components or their products of metamorphosis, the ependymal cells. By the continuous proliferating activity of the '*Keimzellen*' a considerable number of ependymal cells (at least in the case of higher Vertebrates) are gradually created. Thus a definite framework is brought into existence, in the meshes of which further processes of cellular development take place on prescribed lines. About this time the most important differentations in the neural tube begin. The descendants of the '*Keimzellen*' ceasing gradually to turn into ependymal cells are transformed into the mother cells of future nerve cells which, provided with certain histological characteristics, are expressively named '*neuroblasts*.' In the highest Vertebrates, moreover, the offspring of the '*Keimzellen*' appear, provided with still *higher capacity of differentiation*, in so far as they produce a generation of '*indifferent cells*,' which later on differentiate into either *nerve* or *neuroglia cells*.

2. The *ependymal cells*, as a whole, are to be considered as a *phylogenetically older* or an *embryonic stage* of supporting tissue which, in the ascending series of the Vertebrates or in the progress of ontogenetical development, loses gradually its morphological and physiological importance, and is at last replaced by a *cænogenetic* form of supporting tissue, the *neuroglia* proper, the elements of which originate, like the nerve cells, from 'indifferent cells.'

3. The '*indifferent cells*' have the property of *locomotion* (especially developed in those of the cerebellum, where they give rise to the formation of the superficial granular layer of *Obersteiner*), a characteristic of the formative elements of the nervous system which is of great importance for a higher structural complication of the latter.

4. The so-called '*Mantelschicht*' of *His* is in the higher Vertebrates composed of 'indifferent cells' (not only of neuroblasts as *His* supposes), which later on differentiate into either *neuroblasts* or *spongioblasts* (the latter being the mother cells of neuroglia cells).

5. Not all *indifferent cells* undergo simultaneously such an early process of differentiation. A certain number remain for a longer or shorter time in an indifferent condition possessing moreover the property of *further propagation*, which activity is clearly shown by the appearance of karyokinetic figures within the 'Mantelschicht' during a certain period of development. This further proliferation of the structural elements of the neural tube is obviously adapted to furnish the material for the later development and completion of the intricate structure of the nervous system as it is found especially in the higher Vertebrates.

6. It is not improbable that these *indifferent cells* may play an important rôle in *regenerative processes* within the central nervous system even in postembryonic periods.

1. *Cranial Nerves of Bdellostoma dombeyi.* (Read by title.)

2. *The Structure of the Organ of Corti in Adult Man.* (Read by title.) H. AYERS.

The Visual Centers of Arthropods and Vertebrates. W. PATTON.

It is assumed, based on evidence advanced elsewhere, that the median ocellus of *Limulus* and the Arachnids is homologous with the pineal eye of Vertebrates, and that the lateral eyes of *Limulus* and the Merostomata are homologous with the lateral eyes of Vertebrates. In the Arachnids (*Limulus*), and probably in Vertebrates, the distal end of the median eye stalk contains one or more pairs of medianly fused ocelli. (1) From the proximal end of the eye stalk the median eye nerves separate, and encircling the posterior part of the fore-brain, just in front of the posterior commissure, terminate in *Limulus*, on the hæmal side of the fore-brain, in two great lobes which in

position, form and development resemble the lobi inferiori of fishes. In fishes, amphibia and reptiles two strands of nerve fibres associated with the median eye, and springing from a point just in front of the posterior commissures, extend around the sides of the fore-brain and terminate in the neighborhood of the lobi inferiores. Thus the anatomical relations in both Vertebrates and Arachnids are essentially alike. (2) The lateral eyes of *Limulus* and the related fossil forms, owing to more rapid growth of the hæmal margins of the eye, are kidney-shaped, with the helum directed toward the neural side. This gives the most advantageous and economical arrangement of the ommatidia on the convex surface of the carapace of such animals. If such an eye is infolded and forms a part of the brain, as our theory demands, it will not only be turned inside out, but upside down. The most rapidly growing edge will then, in a Vertebrate, be on the neural side and the retina will be kidney-shaped. Under such conditions, as there is no obvious hindrance to continued growth in that manner, the kidney shape will be accentuated, thus bringing the hæmel margins together and forming the characteristic *choroid fissure* of Vertebrates. (3) Such a view implies that the ancestral optic ganglion of Vertebrates is not a part of the retina, as is often assumed to be the case, but a series of ganglionic lobes similar to those belonging to the compound eyes of arthropods.

In insects where the ganglion is beautifully developed it usually consists of three great lobes: (1) a central one the largest, and shaped like a thick hemispherical shell, in fact, having much the same shape as the compound eye itself; (2) a thick semicircular band extending along its whole distal margin (the retinal ganglion); and (3) a nearly spherical ganglion on its proximal side. The latter is united to the base of the fore-brain by a thick stalk, and each ganglion is united with its neighbor by decussating bundles of fibres. The medullary portion of each ganglion is mainly on the hæmal side, the ganglion cells on the dorsal. In *Limulus* we have just such a set of optic ganglia, and in the embryos they project far away from the fore-brain and at right angles to it, as in nearly all other arthropods; but they gradually move backwards toward the wide dorsal line till in the adult crab they lie jammed close together on the hæmal side of the fore-brain near the median line.

Now if the migration of the optic ganglia of *Limulus* should continue in the same direction they would cross the median line and, following the path of least resistance, move in opposite directions towards the open space just behind the cerebral hemispheres.

As the proximal end of the ganglion stalk is fixed to the sides of the fore-brain, the ganglion would be bent double so that the stalk and optic nerve would lie parallel and side by side. The whole ganglion would now form the roof and sides of the mid-brain, and would reverse the direction of its curvature to fit its new position, thus effectively disguising its true character. The ganglion by its change in position is partly inverted, turning the ganglion cell layer toward the ventricle and the medullary portion toward the outside, just as the theory demands. In this position the retinal or most distal ganglion becomes the torus longus, the hemispherical one the tectum opticum, the third one the colliculus; the stalk or proximal end of the ganglion becomes the brachia, and probably such other tracts as unite the various lobes with the thalamencephalon; the crossed nerves form the chiasma and the optic tracts, the fibres in both cases entering what is morphologically the distal end of the series of ganglia, *i. e.*, the torus longus and its vicinity. (4) The commissural

systems support such a comparison. *Limulus* has in each ventral ganglion two sets of transverse commissures, four or five bundles below the remnant of the median furrow, and two above it. Thus a rudimentary '*canalis centralis*' is formed in the *adult* with commissures on either side of it. The entire set of neural commissures in the hind-brain of *Limulus* probably represent the beginnings of the cerebellum. In the fore-brain region of *Limulus* are three main systems of commissures, having the same general relation to the brain that the superior, middle and inferior commissures have in Vertebrates.

Life History and Sexual Relations of the Entoconchidæ. N. R. HARRINGTON.

The *Entoconchidæ* are a very rare degenerate type of molluscs, first observed by Johannes Müller. Since that observation, in 1852, but one contribution to their morphology has appeared. From the discovery of a new genus of this family, living under new conditions, the following facts may be observed:

1. Ontogenetically these forms do not pass through a Thyca or Stilifer stage, as has been suggested by recent hypothesis. They are ejected through the cloacal wall (as are the Cuvierian organs), or else are eviscerated, escaping from the sac by dehiscence.

2. The larva is free swimming and enters the new host with the water taken into the respiratory system, penetrating either the walls of the latter or those of the alimentary tract.

3. The adult sac is produced by the enormous outgrowth of the genital organs and subsequent degeneration of head parts.

4. For the first time in these degenerate shelless molluscs, separate sexes are observed. The males carry spermatophores. This observation takes *Entoconcha* from the evidence employed to show that Hermaphroditism is simpler and more primitive than Gonochorism in the Mollusca.

Budding in Clavilinidæ. G. LEFEVRE.

The only genera of this family of compound Ascidians whose bud development has hitherto been described are *Clavilina* and *Perophora*, but the following is a brief account of the process as it occurs in another genus, *Ecteinascidia*. The material was obtained in Jamaica and belongs to the species *E. turbinata*, Herdman. Although in external appearance the zooids resemble those of *Clavalina*, as they are quite elongated and the two siphons are at the anterior end, the species shows a closer similarity to *Perophora*, both in the structure of the adults and the mode of development of the buds. It differs from the former and agrees with the latter in the total absence of an epicardium and abdomen, but is distinguished from these two forms by the presence of perfect internal longitudinal bars in the wall of the branchial sac. There is nothing like the displacement or rotation of the inner vesicle of the bud rudiment, which has been described for *Perophora*.

The ectoderm of the bud is directly derived from that of the stolon and the inner, or 'endodermal,' vesicle from the stolonic septum, which, however, is not a flat partition, but a tube enclosed within the ectoderm and bathed on all sides by the blood. The bud is connected with the stolon at its posterior end, and its long axis is perpendicular to that of the stolen, as in *Clavelina*.

The pericardium is usually the first organ to appear, and is formed by cells which wander out from the wall of the inner vesicle far back on the right side.

The dorsal tube has a similar origin, but arises at the extreme anterior end of the vesicle, while the ganglion is differentiated out of the dorsal wall of the tube.

The sexual organs are also formed from cells which are given off from the wall of

the inner vesicle, but near the point where the digestive tract is growing out.

It is quite probable that free cells of the blood also take part in the formation of all these organs, as appearances strongly indicate such an occurrence, but these cells themselves are derived from the inner vesicle, which is clearly seen to give them off into the body space, especially at very early stages.

The ectoderm, therefore, is not actively concerned in the bud development, but the duty of providing the material for the formation of all the internal organs devolves solely upon the inner or 'endodermal' vesicle.

Notes on the Structure and Development of the Type of a New Family of so-called Social Ascidians from the Coast of Califoinia. W. E. Ritter.

In its superficial characters the new form closely resembles *Clavelina*. Studied in detail, however, its affinities are found to be much closer with the *Polyclinidæ*, *e. g.*, with the genus *Amaroucium*, than with *Clavelina*. The acidiozoids are wholly distinct from one another, excepting for their attachment to a common basal stolon, as in *Clavelina*, and in form, size and color they closely resemble the zooids of some species of this genus, *e. g.*, *C. savigniana* M. Edw.

They are flute-shaped, the attachment being at the small end. Their average length is about 3 cm. The colonies usually contain many zoöids closely crowded together, as in *Clavelina*. But beyond this the distinctively clavelinian characters cease. The general features of the individual zoöids are distinctly those of the *Polyclinidæ*. The body is divided into three well-defined regions: viz, the thorax, containing the branchial sac; the abdomen, composed mainly of the intestine; and the post-abdomen, containing the gonads and the heart.

In *Clavelina*, on the other hand, the gonads are situated within the intestinal loop, and the heart along side of it—in other words, *Clavelina has no post-abdomen.*

Now it will be noted that the *Polyclinidæ* are entirely typicical ascidiæ compositæ; *i. e.*, not only does reproduction by gemmation take place, but the blastozoids thus produced become closely crowded together and all wholly embedded in a common testicular mass.

This brief comparison will suffice to call attention to the fact, which becomes much more striking when the comparison is carried out in detail, that in the new form we have an ascidian which *in the relation of the blastozoides to one another in the colony is strictly a so-called social ascidian, while in the structure of the individual zoöids it is as strictly a compound ascidian.*

Another illustration is thus produced of the artificialty of a classification of the tunicata which attempts to base primary subdivisions on the condition of the blastozoides of the colony as regards a common test-mass.

The characters which prevent the form from being admitted to the family *Polyclinidæ*, and make necessary the establishment of a new one for it, are founded in the structure of the gonads and the oviduct; the relations of the epicardiac tubes; and in the arrangement of the branchial tentacles.

The study of the embryology is still quite incomplete. The embryos are developed in a long expanded proximal portion of the oviduct which may properly be called a uterus. About a dozen embryos are found in each uterus, these being placed in a single row, usually with the oldest farthest forward and the youngest nearest the ovary, or farthest back.

The larval stage is much abridged, the metamorphosis of the nervous system being nearly complete before the larva leaves the parent. It is doubtful if there is any free-swimming tadpole stage at all.

Numerous amœboid cells are always present in the uterus among the embryos. These are probably concerned in the nutrition of the embryos, since they may be seen passing through the uterine wall, and the uterus is surrounded by a great quantity of cells filled with yellow granules, probably of food material.

Perhaps the most important developmental point thus far made out is that the peribranchial sacs *arise as two well defined ectodermal invaginations on the dorsal side of the embryo.*

The results, then, support the conclusions of Kowalevsky, Seeliger, Willey, Hjort and Caullery on this head, and oppose those of Della Valle, van Beneden et Julin, Pizon and Garstang, who hold, in one way and another, that these structures arise from the endoderm.

Notes on Chelyosoma productum, Stimpson. F. W. BANCROFT.

An examination of about 20 individuals in the collections of the University of California shows that this western ascidian is quite distinct from its Atlantic and Arctic representative, *C. macleayanum.* Stimpson describes the species as having the disk, which is characteristic of the genus, divided into fourteen plates; but in the individuals examined the number was found to vary from thirteen to twenty. This variability is associated with a muscular system that is quite different from what is found in the other member of the genus. In *C. productum* the systems of short muscles joining adjacent plates are wanting, except around the orifices, and are replaced by a series of fibres extending from near the center of the disk to its periphery and some distance down the sides of the animal. The method of attachment of these muscles is different from that described for any other ascidian. Both ends of every bundle of muscle fibres are firmly attached to little projections of the inner surface of the test. On these the ectoderm is thrown into deep folds and pockets which greatly increase the surface of contact with the test, so that the muscles which are joined to the inner ends of the ectoderm cells cannot tear them away.

The matrix of the test, like that of some other tunicates, consists of an inner layer of cellulose and an outer one, very distinctly separated from it, which is not cellulose, and which corresponds to the 'yellow layer' of the early authors. In our species it is easily seen that this outer layer is formed from the cellulose matrix by the activity of the mesodermic bladder cells which the latter contains. The first traces of the 'yellow substance' are seen about isolated bladder cells near the outer layer, and all transitions can be traced from this stage until the cell and the yellow substance it has produced are incorporated into the outer layer. The other organs of *Chelyosoma* are of a less exceptional character and clearly show that it is more closely related to *Corella* than to any other genus.

On the Plan of Development of a Myxinoid. BASHFORD DEAN.

The marked dissimilarity in the development of Bdellostoma and Petromyzon was noted. In the former a large supply of yolk produces a merocytic condition at a very early stage; The head region of the embryo, appearing first, very much as in Elasmobranchs, takes its position near the animal pole; the body region is then laid down, apparently by concrescence, in an almost straight line extending in the direction of the yolk pole almost the entire length of the egg. The subsequent growth of the embryo constricts both head and tail from the yolk sac, and in very late stages an embryo of nearly two inches lies coiled within the egg A preliminary study confirms Professor Price's observations as to the great number of gill slits.

On the Early Development of Chimæra. Bashford Dean.

Emphasis was laid on the similarity of the embryonic characters of Chimeroid and Elasmobranch.

Amphiuma and the Cæcilians. J. S. Kingsley.

The various statements which had been advanced to show the relationships of *Amphiuma* and *Cæcilians* were considered, and it was pointed out that these statements were almost entirely based upon misinterpretation or misconception. The differences between the two were then emphasized, and it was shown that the structural features were opposed to the view of Cope that the Cæcilians had descended from an Amphiuma-like form, and to that of the Sarasins that *Amphiuma* was a neoteric Cæcilian. In the possession of an ethmoid, in structure of vertebræ, in the relations of palatine and trigeminal nerves, in structure of nephridia and genitalia and in circulatory apparatus, the Cæcilians differ from *Amphiuma* and from all Urodeles, and the group must be regarded as entirely distinct from Urodeles, and as having descended directly from some Stegocephalan ancestor.

Vertebral Intercalation in Necturus. (Read by title.) H. C. Bumpus.

Brachial and Lumbo-sacral Plexi in Necturus. F. C. Waite.

In *Necturus maculosus* the normal position of the pelvic girdle is with attachment to the 19th vertebra, but in about one-fourth the cases it is attached to the 20th vertebra. Unfrequent cases are found in which the attachment is asymmetrical, the sacral rib on one side being one segment anterior to that on the other side.

Study of the plexi in a series of specimens shows: (*a*) that the position of the brachial plexus does not vary with displacement of pelvic girdle, and so it is improbable that intercalation of vertebræ occurs anterior to the posterior spinal nerve (V) involved in this plexus; (*b*) with normal position of pelvic girdle there are two prevalent types of topography of the lumbo-sacral plexus which depend upon the manner of branching of the spinal nerves to form the crural nerve, and further that there is considerable variation in the strength of the nerves involved, causing a shifting within narrow limits of the 'source center' of the plexus. (*c*) When the girdle is attached to 20th vertebra the plexus shows a displacement posteriorly, but not in a corresponding degree through an entire segment. It thus occupies a position intermediate between the normal position and what would be its position were it displaced through an entire segment. (*d*) Where the girdle is attached asymmetrically the plexus does not show corresponding asymmetry, but is essentially symmetrical in one of the two segments involved.

The intermediate position of the plexus, the occurrence of symmetrical variation in position of girdle; of asymmetrically placed girdles and of supernumerary sacral ribs, appears to be explicable not upon ground of intercalation of vertebra nor of slipping of girdle during ontogeny, but upon the hypothesis that there are several segments in this region, in any one of which a girdle may be developed.

Discovery of a Huge Octopus on the Coast of Florida. A. E. Verrill.

The following officers were elected: President, C. S. Minot, Harvard; Vice-President, S. I. Smith, Yale; Secretary-Treasurer, G. H. Parker, Harvard; Members of the Executive Committee from the Society at large, J. S. Kingsley, Tufts, and Bashford Dean, Columbia.

G. H. Parker,
Harvard University. *Secretary.*

CURRENT NOTES ON PHYSIOGRAPHY.

CAMPBELL ON DRAINAGE MODIFICATIONS.

THE processes whereby rivers re-arrange their courses when the region that they drain is affected by gentle deformation is thoroughly treated by M. R. Campbell (Chicago Journ. Geol., IV., 1896, 567–581, 657–678). He gives a detailed deductive consideration of expected changes, leading to the 'law of the migration of divides;' in brief, that divides migrate towards an axis of uplift. It is further shown that, under the influence of tilting, rivers will, by the migration of divides, tend to arrange themselves in rectangular pattern, the smaller streams running down the dip, the larger along the strike of the tilt. Streams are most sensitive to these influences in their old age, when, by long striving, each individual has come to be so delicately balanced against its neighbors that the least outside influence may cause predatory conquests by the more favored. Several examples are given of rivers in the Appalachian region which appear to have been affected by changes of the kind here discussed; among these the Chattahoochee, New and Roanoke rivers being especially interesting.

To the student of the natural history of rivers this discussion by Campbell must be particularly acceptable, inasmuch as it introduces the competent consideration of an element of disturbance not sufficiently attended to in earlier studies of the development of river courses.

RUSSELL'S GLACIERS OF NORTH AMERICA.

UNDER the above title Professor I. C. Russell has prepared another 'reading lessons for students of geography and geology' (Ginn & Co., Boston, 1897), a companion to his Lakes of North America, and has thereby placed teachers and students alike under many obligations to him. Good geographical literature, neither in text-books nor in advanced professional reports, but in accessible and attractive form for ready use, is so rare that teachers are often at a loss where to find it; and students who reach an impressible, interrogative attitude are perforce left unsupplied with answers to their questions. It is only as books like these 'lessons' of Russell's increase in number that the studious treatment of geography can flourish. This book on glaciers is doubly welcome at the present time of a growing interest in geographical science. We find first a general account of glaciers and of their modern and ancient action; then several chapters on the existing glaciers of various districts in North America, the brevity of the chapter on Canada pointing clearly to that district as most in need of further exploration. Closing chapters discuss climatic changes indicated by glaciers, why glaciers move, and the life history of a glacier; the latter being especially recommendable from its novelty and breadth of view. The book contains many excellent illustrations.

THE GOHNA LANDSLIP.

A REMARKABLE instance of foresight in averting disaster is found in an account of the Gohna landslip on a head branch of the Ganges, in the Garhwal Himalaya, and of the flood that followed on the overflow of the resulting lake, as published by the Public Works Department of the Government of India (Calcutta, 1896). The slip occurred in September, 1893, continuing three days with deafening noise, darkening the air with the dust from shattered rocks, and clogging the narrow valley with 800,000,000 tons of detritus. The fall descended about 4,000 feet, spreading about two miles along the valley and rising 850 feet above the former stream level. It resulted from the undercutting of strata that dipped into the valley, and hence should be classed with those slides that follow the erosion of narrow valleys in uplifted

masses; as such, being a characteristic of vigorous young mountains.

Careful study of the ground made it clear that no artificial discharge could be made for the rising lake. As the impending flood could not be controlled, every effort was made to insure the safety of the people in the valley below by timely warning of the disaster. A telegraph line was constructed from Hardwar, on the Ganges at the edge of the plains, to Gohna, 150 miles within the mountains. In April, 1894, August 15th was set as the probable date of the flood. A number of suspension bridges were dismantled and removed. Safety pillars were set up on the valley slopes, at intervals of half a mile, and at heights of from 50 to 200 feet above the ordinary river level, thus indicating the probable limit of the flood, above which there would be no danger.

The lake back of the dam grew to be four miles long and half a mile wide. At midnight of August 25th–26th, during a heavy rainfall, the flood began. In four hours the lake was reduced to two miles in length and quarter of a mile in breadth; 10,000,000,000 cubic feet of water were discharged, cutting down the barrier 390 feet; advancing at a rate of twenty miles an hour at first, and ten miles an hour further down the valley, sweeping away many miles of valley road, completely destroying two bridges that had been left standing, because of remonstrances from local authorities against their removal, and leaving no vestige of many villages and three considerable towns; yet so fully was the danger announced that not a single life was lost.

W. M. Davis.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

THE AMERIQUE INDIANS.

There has lately appeared in Paris a book with the title 'L'Amerique a-t-elle droit sous ce nom à un nom indigène?' by M. Franciot-Legall.

The question discussed is one which at various periods has risen in the Congrès Internationale des Américanistes, and derives its origin from the fact that somewhere in Central America there has been known a native tribe with the name 'Ameriques;' and it was argued that Columbus in his fourth voyage met this tribe and from it his associates gave the name to the land, —not from Amerigo Vespucci, as the geographer Waldseemüller says, or, at least, independently of him.

Some have doubted that there was a tribe so-called, but their existence must be conceded. They have been met by explorers of the present day—by Mr. Crawford, for example. Their affinity and precise location have, however, not been stated. These points have been settled lately by M. Alph. Pinart, who, as he lately informed me, secured a vocabulary of their tongue and found it to be of the Lenca stock, and their present home to be in the State of Honduras.

30TH REPORT OF THE PEABODY INSTITUTE.

The last report of the Curator of this institution, Professor F. W. Putnam, shows it to be in a flourishing condition. Among the results of its field work are numerous specimens of chipped stones said by the Curator to be 'found in the glacial deposits of the Delaware Valley,' about the age of which deposits it is fair to say geologists are not agreed.

Mr. Gordon's researches in Copan are referred to, and the fact emphasized that the establishment of that city was far more ancient than the surface ruins and standing monuments.

The report closes with some excellent suggestions for a course of instruction in anthropology, comprising a group of studies some acquaintance with which is essential to

an anthropologist. It necessarily includes several departments, but in a period of three years a diligent student could be qualified for original research.

PLIOCENE MAN IN BRITAIN.

GEOLOGICAL readers are aware that the Cromer Forest Beds of eastern England are to be assigned to either the latest Pliocene or oldest Pleistocene. They are distinctly preglacial and contain remains of a subtropical fauna.

From an article in *Natural Science*, for January, it appears that Mr. W. J. Lewis Abbott has collected from these beds a series of chipped flints bearing 'a striking resemblance to the work of man,' and have been pronounced to be such by competent experts. One showed a plain 'bulb of percussion.'

As there seems no doubt about their deposition with the original strata, the only question remaining is their production, whether by the hand of man or natural agencies. There still remains some doubt even as to the flints from the plateau of Kent on this vital point.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

ON January 11th Professor Clemens Winkler, of Freiberg, delivered an address before the Deutsche Chemische Gesellschaft on The Discovery of New Elements during the last twenty-five years and problems connected therewith. He first considered the quantitative distribution of the elements, showing by Professor F. W. Clarke's tables that as far as concerns the outer ten miles of the earth, together with the atmosphere, one-half of all the material is oxygen, and one-quarter is silicon, and that these two elements, with aluminum, iron, calcium, magnesium, sodium and potassium make up over 7.5 per cent. None of the remaining elements occur in as great abundance as one per cent. In the process of cooling of the earth, and subsequent geologic action, many of the less abundant elements have become somewhat localized or concentrated; as, for example, chlorin in the sea and in salt deposits, the heavy metals in veins and lodes. Were this not the case many of the rarer elements must have escaped detection. An instance of this is scandium, discovered by Nilson in 1879, of whose oxid but a few grams exist. This element, and gallium, discovered by Lecoq de Boisbaudran in 1875, and germanium, discovered by Prof. Winkler himself in 1886, possess a peculiar interest, in that the properties of each had been quite accurately predicted by Mendeléef in 1871. Their discovery was a complete confirmation of the principles of the periodic law. The mineral gadolinite, with others closely kin, has been a fertile source of investigation, and the list of 'rare earths' that have been discovered in it is apparently by no means complete. Erbium, holmium, thulium, dysprosium, terbium, gadolinum, samarium, decipium and ytterbium have been discovered by various observers, but the independent existence of several of these is far from certain. Of several supposed new elements the non-existence is more sure; such are metacerium, russium, jargonium, austrium, norwegium, actinium, idumium and masrium. The same may, perhaps, be said of the recently *patented* lucium, kosmium and neokosmium. (These last do not derive their appellation from *kosmos*, but from Kosmann, their discoverer and patentee!). Work by Auer von Welsbach on his incandescent light led him to the decomposition of didymium into neodymium and praseodymium, whose beautiful red and green salts were well shown at the Chicago Exposition. The last elements considered by Professor Winkler were argon and helium. These apparently do not as yet fall into

harmony with the periodic system. The same may be said of tellurium and cobalt or nickel. Whether some or all of these elements are mixtures or whether their seemingly anomalous atomic weights must be explained in some other way does not as yet appear.

The action of the silent electric discharge in effecting chemical synthesis is being studied by Losanitsch and Jovitschitsch at the Königliche Hochschule at Belgrade. The apparatus used is an ordinary ozonizator, or, as they prefer to call it, electrizator. Mixed gases are led through the apparatus, exposed to the discharge of a Ruhmkorff excited by a current of 70 volts and three to five amperes. Carbon monoxid and water, also carbon dioxid and hydrogen, are condensed to formic acid; carbon dioxid and water yield formic acid and free oxygen; carbon monoxid and hydrogen give formaldehyde, which quickly polymerizes, apparently to a polymer glycolaldehyde. Carbon dioxid and methane condense to acetaldehyde, which soon forms aldol. A general method for formation of aldehydes is thus presented. Nitrogen and water condense directly to ammonium nitrite, a fact known to Berthelot, and considered to have a bearing on plant nourishment. Other interesting syntheses were obtained with sulfur compounds and with ammonia. In general, the reactions seem to be rather the reverse of those produced by heat.

The December *Zeitschrift für physikalische Chemie* contains a study by Paul and Krönig on the behavior of bacteria towards solutions of different salts. All salts of the same metal do not have the same germicidal effect upon the spores of the anthrax bacillus used for most of the experiments. Thus mercuric chlorid is more deadly than mercuric cyanid. Apparently those solutions containing the largest number of free ions of a metal possessing a specific poisonous character are most active. Mercuric chlorid is more completely dissociated in solution than the cyanid. Alkaline chlorids are often used to promote the solution of mercuric chlorid, but they also decrease the antiseptic power of the solution, since they diminish the dissociation and hence decrease the number of free mercuric ions. Dissolved in alcohol, mercuric chlorid has practically no effect on anthrax spores.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

REVUE DE MÉCANIQUE.*

A notable addition to the list of technical journals has been made in the establishment of this monthly. Its editors, Messieurs Haton, Bienaymé, Bourdon, Brüll, Collignon, De Comberousse, Flamant, Hirsch, Imbs, Linder, Raffard, Rozé, Sauvage, and the responsible collaborateur, Richard, all stand among the foremost men of applied science and engineering of France. They include the distinguished head of the École des Mines, member of the Institute, the inspector-general of the navy, a famous inventor and constructor, a past-President of the French Society of Civil Engineers, two inspectors-general of roads and bridges, two professors at the Conservatoire des Arts et Metiers, the engineer-in-chief of *ponts et chaussées*, upon whom the French government is accustomed to rely for advice respecting all its public works and especially at its international exhibitions, the inspector-general of mines, and the engineer-in-chief, and also a representative of the École Polytechnique.

This first volume opens with a prospectus indicating the scope of the plans of the editors and the field to be occupied by the new journal. The leading article is an extensive paper, sixteen pages, by M. Dwelshanvers-Dery, of the University of Liege; *Détermination des données fondamentales dans un essai de Machine à Vapeur*, in which the famous author gives, in full detail, the

* *Publiée sous le Patronage et le Direction technique d'un Comité de Rédaction, composé de* MM. Haton de la Goupillière, etc.; *Secrétaire de Rédaction*, G. Richard. Paris, P. Vicq-Dunod et Cie. Tome I., No. 1, Janvier, 1897.

methods employed by him in the analysis of the action of steam within the engine, and in the measurement of the heat and steam passing through its cylinder and in the determination of their various directions of useful application or of waste. This method is, in the main, that of Hirn, but reduced to algebraic expression by Dwelshauvers, and given application in scientific work of vastly more exact nature than was practicable in the time of the great master. The 'experimental engine' established within a few years at the School of Mines of the University of Liege affords M. Dwelshauvers opportunity to illustrate the principles enunciated and to secure original and helpful data, while, at the same time, giving practical instruction to his students.

A paper by M. Boulvin, of the University of Ghent, on 'Le Diagramme entropique et ses applications' follows. This diagram and method of representation of thermodynamic operations, original with our own Professor Gibbs, nearly a quarter of a century ago, is just attracting attention among scientific practitioners in engineering by its peculiar adaptation to the exposition of the effects of transformations upon the relative volumes of fluids, losing or gaining heat while work is being done. The pressure-volume diagram is usually better adapted to the needs of the engineer; but this special form of chart, the temperature-entropy diagram, better exhibits the physical condition of the fluid during the progress of the engine cycle. M. Boulvin, in his article, shows its practical uses, as particularly applied to the study of the permanent gases used as working substances in heat engines.

M. Sauvage studies the compound locomotive engine, exhibiting the structure of the principal classes in great detail and giving much attention to the forms familiar in the United States. M. Richard similarly discusses the refrigerating machines, giving detailed descriptions of the principal parts of such apparatus and according large space to those observed by him at the Chicago Exhibition of 1893. The same prolific pen offers an account of the construction of the later forms of the gas and petroleum engines. A 'chronicle' of current novelties and a review of contemporary literature conclude the volume, which occupies 112 giant pages.

With such extraordinary editorial support, and with such contributors, the new journal should promptly assume a place among the leading periodicals of its class; in fact, it may be said to have done so with this first issue.

The following original papers are announced as in preparation for succeeding numbers: L'Influence des parois dans les machines à vapeur, par Bryan Donkin; Le Surchauffe, par M. Sinigaglia; La Machine à vapeur américaine, par M. Thurston; Las Machines à vapeur marines, par M. Roche; Les Chaudiéres, par M. Walkenauer; Les Pompes, par M. Masse; Les Régulateurs, per M. Marie; Les Appareils de levage, Les Machines-outils, par M. Richard.

GENERAL.

MR. J. H. BRIGHAM, of Ohio, has been appointed Assistant Secretary of Agriculture.

THE fourth session of the Congress of American Physicians and Surgeons will be held at Washington, D. C., on May 4th, 5th and 6th, under the presidency of Professor W. H. Welch, of Johns Hopkins University. Fourteen of the most important medical societies, including the Physiological Society and the Society of Anatomists, will take part in the Congress. One of the three general meetings will be devoted to a discussion of 'Internal Secretions considered in their Physiological, Pathological and Clinical Aspects.' Dr. William H. Howell, of Baltimore, Md., and Dr. Russell H. Chittenden, of New Haven, Conn., will speak in behalf of the American Physiological Society. Dr. J. George Adami, of Montreal, Canada; Dr. James J. Putnam, of Boston, Mass., and Dr. Francis P. Kinnicutt, of New York City, in behalf of the Association of American Physicians, and Dr. William Osler, of Baltimore, Md., in behalf of the American Pediatric Society. The papers will be followed by a discussion.

THE anniversary meeting of the Geological Society of London was held at Burlington-house on February 17th. The officers were appointed as follows: President, Dr. Henry Hicks, F. R. S.; Vice-Presidents, Professor T. G. Bonney, F. R. S.; Lieutenant-General C. A. M'Mahon, Mr. J. J. H. Teall, F. R. S., and Dr.

Henry Woodward, F. R. S.; Secretaries, Mr. J. E. Marr, F. R. S., and Mr. R. S. Barries; Foreign Secretary, Sir John Evans, F. R. S.; Treasurer, Dr. W. T. Blanford, F. R. S.. The following awards of medals and funds were made: The Wollaston medal to Mr. W. H. Hudleston, F. R. S.; the Murchison medal and part of the fund to Mr. Horace B. Woodward, F. R. S.; the Lyell medal and part of the fund to Dr. G. J. Hinde, F. R. S.; the Bigsby medal to Mr. Clement Reid; the balance of the proceeds of the Wollaston fund to Mr. F. A. Bather; the balance of the proceeds of the Murchison fund to Mr. S. S. Buckman; the balance of the proceeds of the Lyell fund to Mr. W. J. Lewis Abbott and Mr. J. Lomas. The President delivered his anniversary address, which dealt with some recent evidence bearing on the geological and biological history of early Cambrian and pre-Cambrian times.

The Council of the Royal Photographic Society of Great Britain have awarded the progress medal of the Society to Professor Gabriel Lippmann, of Paris, for his discovery of the process of producing photographs in natural colors by the interference method.

A select committee of the British House of Commons has been appointed to inquire into and report upon the sufficiency of the law relating to the keeping, selling, using and conveying of petroleum and other inflammable liquids, and the precautions to be adopted for the prevention of accidents with petroleum lamps.

The Supreme Court of the State of Wisconsin has declared compulsory vaccination to be unconstitutional on the grounds that it may be objected to as a matter of conscience and its enforcement would be an interference with religious liberty.

The Council of the Sanitary Institute of Great Britain have accepted an invitation of the City Council of Leeds to hold a sanitary congress and health exhibition in that city in September.

The Senate has passed a joint resolution reciting the alarming spread of the bubonic plague now prevalent in India, and directing the Secretary of the Treasury to establish such national quarantine regulations as may become necessary to prevent the introduction and spread of infectious or contagious diseases. The resolution provides for the appointment of inspectors by the Secretary of the Treasury, on the advice of the surgeon-general of the Marine Hospital service, and for the inspection of vessels, persons, etc., pending the existence of the emergency.

The British Medical Journal states that a careful and comprehensive report on the progress of public hygiene in Prussia during the years 1889, 1890 and 1891 is being circulated by the Medical Board of the Prussian Cultus-Ministerium (Ministry of Education, etc.). It is a book of more than 600 pages, comprising chapters on every branch of public health and on epidemics in man and beast, besides a large number of statistical tables. The latter include general mortality, mortality at different ages, mortality from different specified diseases, and disease and mortality in different trades. The problems of water supply and drainage, police supervision of food and drink, supervision of factories and schools, etc., are fully discussed, and there are chapters on workmen's dwellings, working colonies, poorhouses, almshouses, hospitals, etc.

Professor W. M. Spaulding writes us of the death of Lorenzo N. Johnson, formerly instructor of botany in the University of Michigan, which occurred at Boulder, Colorado, Saturday, February 27th. "Mr. Johnson was an enthusiastic student of algæ and fungi and had devoted much time to systemmatic work on the Desmidiaceæ. He was the author of various papers on this group and had much extended their known range in the United States."

We regret also to record the death of Mr. John Pierce, formerly professor of chemistry in Brown University, and of Professor Edward Thomson Nelson, of the chair of science in Ohio Wesleyan University, on February 28th.

At the instance of the Commission on Bird Protection of the American Ornithologists' Union, the Lighthouse Board at Washington has issued a decree forbidding the sale of eggs of the sea birds of Farrallones Islands, California. It is said that as many as 20,000 dozen eggs were annually sold.

According to the *Electrical World*, on June 26th next an exhibition will be opened in the

Exhibition Building, Sydney, N. S. W., and will continue during the months of July and August. It is intended to embrace engineering in all its branches, and the exhibits will consist of raw material, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relative to scientific, mechanical and educational works, in classified sections. The object of the exhibition is solely for the advancement of engineering science and the promotion of a general and practical education therein.

IT is stated in the daily papers that what appears to be a volcano has burst forth in the Great Salt Lake, a short distance southwest of Promontory Station on the Central Pacific Railway. The phenomenon first appeared recently in the form of a small cloud hovering over the water about a mile and a quarter from the shore. It gradually increased in dimensions and shotup so high in the air that it is now visible for a great distance, and the water in the immediate vicinity boils and seethes and the spray is thrown up in the air for hundreds of feet.

AT a recent meeting of the executive committee of the National Trust for Places of Historic Interest or Natural Beauty, Sir Robert Hunter in the chair, it was determined to take steps to initiate a regional survey of the country, and, by means of local correspondents, initiate the compilation of a catalogue of buildings, objects and places of historic and archæological interest, with a view to their proper protection and preservation. A report by the Treasurer showed that the work of repairing and making sound the old clergy-house at Alfriston (which has recently been acquired by the Trust) had had to be suspended on account of lack of funds, a sum of £200 being still needed. It was announced that the transfer of Barras Head, opposite Tintagel Castle (which has recently been acquired by the Trust) was complete. The committee were unanimous in agreeing to resist the Hastings Habour District Railway Bill on the ground of its serious interference with features of natural beauty in the district.

IT is stated in *Nature* the government of the Colony of the Cape of Good Hope has undertaken an investigation of the marine fauna of of the South African coast. A small marine station will probably be erected on False Bay, and a suitable steam vessel of about 150 tons is now being built for the station. The services of specialists are invited to work up the material that may be procured, under the following arrangements: Specimens will be forwarded as procured, and, on receipt of manuscript and drawings each piece of work will be published without delay in a uniform style, so as to form ultimately a complete record of the Cape marine fauna. Author's copies will be forwarded as soon as published, and a certain circulation will be guaranteed. No money remuneration is offered, but duplicate specimens may be retained by the authors. Unique specimens will be handed over to the South African Museum in Cape Town. Further information will be supplied on application to J. D. F. Gilchrist, Marine Biologist to Cape Government Agricultural Department, Cape Town.

WE have already noticed the return of Mr. J. E. S. Moore from his scientific expedition to Tanganyika. In conversation with a representative of Reuter's Agency Mr. Moore said that he left England in September, 1895, and proceeded to Chindi, thence going by a British gunboat to the north of Lake Nyasa. At Karongas he got together his caravan consisting of about 50 men, some of whom were armed with rifles. There was, however, no likelihood of difficulty with the natives. He then marched along the Stevenson Road to the south end of Tanganyika, where the Chartered Company placed at his disposal a steel boat. He commenced his researches in the beginning of April, 1896, and concluded in September. He found the fauna of Tanganyika to be unique—unlike anything else anywhere—and as limited as peculiar. The jellyfish and shrimps were certainly of a marine type while the geology of the district precluded the possibility of any connection with the sea in recent times. The water of this lake, which Livingstone found to be brackish, was now quite drinkable. All this seemed to prove that the Tanganyika part of the great rift valley running through that part of Africa at one time had access to the sea, while it was perfectly clear that Lake Nyasa,

some 246 miles to the southeast, apparently never had any marine connection. It was also a matter of interest that the fauna of Tanganyika was not only marine, but of a very peculiar and primitive type, and it was quite reasonable to suppose that the characteristics of the fauna were connected with the remote geological connection of the lake with the sea.

THE first census of the Russian Empire was completed on February 9th. The work has been in preparation for several years past, being carried out with the aid of the statistical committees and the Imperial Geographical Society. The inevitable difficulties, due to the vastness of the Empire and the diversified character of the people, have been increased by their ignorance and superstition. They are said to fear not only fresh taxes, but also a re-introduction of serfdom.

UNDER the title 'Magnetic Declination in the United States,' the United States Geological Survey has just published a compilation and discussion of magnetic declination, by Mr. Henry Gannett, which will be of value to surveyors throughout the country. The compilation is based upon magnetic observations made at about 22,000 stations. All data obtainable for the discussion of the secular variation in declination have been used, and the results are presented in the form of tables, showing the approximate reduction to a selected epoch—namely, the year 1900—at each tenth year prior to that time for the period during which it may be required. Finally, the declination data have been reduced to this epoch, 1900, and are presented in the table by counties, cities and towns. The calculated distribution of the magnetic declination for the United States in 1900 is graphically exhibited upon a map in a pocket in the cover. W. F. M.

WE have received from Dr. J. Milne an advance copy of a circular to be issued by the Seismological Investigation Committee of the British Association, asking cooperation in an endeavor to extend and systematize the observation of disturbances resulting from large earthquakes. The Committee recommend that similar instruments be used at all stations and are prepared to supply, for about £50, an instrument to those willing to forward to them notes of disturbances having an earthquake character, for analysis and comparisom with the records from other stations. From time to time the results of these examinations would be forwarded to each observatory. The first object in view is to determine the velocity with which motion is propagated round or possibly *through* our earth. To attain this, all that is required from a given station are the times at which various phases of motion are recorded; for which purpose, for the present at least, an instrument recording a single component of horizontal motion is sufficient. Other results which may be obtained from the proposed observations are numerous. The foci of submarine disturbances, such, for example, as those which from time to time have interfered with telegraph cables, may possibly be determined, and new light thrown upon changes taking place in ocean beds. The records throw light upon certain classes of disturbances now and then noted in magnetometers and other instruments susceptible to slight movements, whilst local changes of level, some of which may have a diurnal character, may, under certain conditions, become apparent. Those willing to cooperate in this important investigation should address The Seismological Committee, British Association, Burlington House, London, W.

UNIVERSITY AND EDUCATIONAL NEWS.

THE faculty of Mt. Holyoke College announce the gift to the College of $40,000 for a dormitory by Mr. John D. Rockefeller, of New York, and the receipt of a check 'from a friend' for $2,250.

SOME months ago it was announced in SCIENCE (August 7, 1896) that the University of Texas, through the liberality of Hon. George W. Brackenridge, of San Antonio, a member of the Board of Regents, had come into the possession of the finest collection of recent shells west of the Mississippi. We now have the pleasure of recording a supplementary gift from the same generous donor consisting of the Galveston Deep Well Collection, numbering 102 species; a collection of Eocene, Miocene and Pliocene fossils from California, Texas and other Southern States, 106 species; a collection

of Texas Carboniferous and Cretaceous fossils, 58 species, and 157 specimens of Texas flints (implements). This material was brought together by Mr. J. A. Singley, the well-known collector, now a resident of Giddings. In the mean time the library of the law department has been increased by the addition of nearly two hundred volumes, presented by Ex-Governor O. M. Roberts. The gift from the first professor of law is greatly appreciated. The largest donation, however, is that announced on February 23d. On the day preceding the Palm library, consisting of 25,000 volumes, the largest private collection in Texas and probably in the Southwest, was formerly turned over to the University by its owner, Mr. Swante Palm, of Austin. It contains many rare and costly volumes brought together from the great book centers of the world. 'The collection,' it is said, 'embraces not only general literature, history, biography, travels, science and philosophy, but also a remarkable collection of art books, illustrating ancient, medieval and modern art, custom and manners.' Mr. Palm is a native of Sweden and a resident of Texas for over fifty years. In 1883 he was knighted by King Oscar. The University library now contains over 40,000 volumes.

FREDERIC W. SIMONDS.

THE will of the late Anson Chapell, of West Hartford, Conn., leaves $3,000 to Washburn College, Topeka, Kans., and the same amount to the Hampton Normal and Agricultural Institute of Virginia.

AT the regular March meeting of the trustees of the New York University it was decided that the control of the University Medical College should be vested in the Council., The Medical College Laboratory, said to be worth $400,000, is transferred to the Council, which body will hereafter be responsible for the appointment of professors. Chancellor MacCracken announced at the meeting that the Building Committee had made a contract for the construction of the new library building at University Heights. The material used in construction will be grayish yellow Roman brick and Indiana limestone. The building will have a depth of 200 feet and will be 100 feet wide.

IT is reported that the investigation of the University of Wisconsin by a Legislative committee shows that the University has overdrawn its account at the State treasury to the amount of $145,944.76.

THE syndicate of the University of Cambridge appointed to consider the question of granting degrees to women has reported in favor of conferring the degrees of B.A. and M.A. under certain conditions, but against admitting women to membership in the University.

WE recently gave the percentages of hours devoted to different departments at Harvard and Yale Universities. The Boston *Transcript* has now published similar figures for Cornell University and the New York *Post* for Princeton University. While we cannot vouch for the accuracy of these figures they seem sufficiently interesting to deserve repetition.

	Harvard.	Cornell.	Yale.	Princeton.
Classics	8.7	8.0	24.2	22.6
European languages	22.8	18.8	14.5	12.4
English	16.8	16.3	10.9	11.3
Political science	9.9	6.5	11.2	9.6
History	14.3	8.2	10.4	
Mathematics	4.4	6.6	9.6	19.4
Philosophy	6.1	7.7	8.9	8.6
Natural science	10.2	23.5	8.1	8.8

It thus appears that Yale and Princeton agree somewhat closely in the distribution of studies, except for the excess in mathematics at Princeton. Harvard and Cornell also agree to a considerable extent, but Cornell devotes one-fourth of the entire time (the figures refer to the academic department) to science. It is noteworthy that in the Senior year at Princeton, when the studies become elective, only 3.8 per cent. of the time is given to the classical languages, and 15.1 per cent. to natural and physical sciences. The classical languages evidently only hold their position at Yale and Princeton through compulsion. European languages tend to take their place in large measure with some gains by English and the sciences.

IT is stated in the London *Times* that at a meeting of Edinburgh University Court it was reported that, in addition to the sum of £5,000, less legacy duty, bequeathed to the University in 1893 by the late Mr. A. L. Bruce, Edinburgh, towards the founding of a chair of pub-

lic health, a further donation of £1,063 for the same object had been intimated from Mrs. Bruce and other members of the family. It was also reported that an offer of £5,000 towards the same object had been received since last meeting of the Court from a gentleman whose name, at his own request, is not to be made known for the present. The Court, considering that the amount of donations approximates the sum which they think to be necessary for the endowment of the proposed chair, resolved to request the Universities' Commission to frame a draft ordinance instituting a separate chair of public health in the University.

Dr. Otto Fischer, professor of chemistry at the University at Erlangen, has been called to Kiel; Dr. W. Felix has been promoted to an associate professorship of anatomy at the University of Zurich. Dr. August Pauly has been made associate professor of comparative zoology at the University of Munich and director of the division of zoology at the forestry experiment station. Professor Pasquele Baccarini has been appointed professor of botany at the University of Catania and Dr. Oswald Kruch professor at the agricultural experiment station in Perugia.

DISCUSSION AND CORRESPONDENCE.

OPPORTUNITIES FOR TRAINING IN PHYSIOLOGY.

The department of physiology in the Harvard Medical School offers to four qualified men positions in which training in physiology may be obtained.

It is expected that these men will give the mornings of the collegiate year to research and the afternoons to the direction of undergraduate students in experimental physiology, under the supervision of a professor in the department.

Every effort will be made to instruct the holders of these positions in the ways of framing problems for investigation, in the principles of criticism, in the technical methods of research, and in the manner in which the results of an investigation should be put together for publication. Instruction will be given also in methods of teaching, including the arrangement of lectures, the division of subject-matter between the systematic course covering the entire field and the advanced special lectures, the physiological conference, the Journal Club, the use of the projection lantern in physiological demonstration, and the demonstration of physiological experiments to large and small classes.

The direction of laboratory work will be an important part of the training. The first year class in the Harvard Medical School is divided into sections of thirty-two. Each section works twenty-four afternoons in experimental physiology, making more than one hundred experiments, such as the influence of temperature on the form of the muscle curve, the phenomena of electrotonus, the compensatory pause of the heart, the use of the artificial eye, the ophthalmoscope, laryngoscope, sphygmograph, etc. etc. The repetition of fundamental experiments in this course, and the great variety afforded by so many experimenters working at the same time, secure to the directors of the work a thoroughness and a breadth of training in elementary physiology scarcely attainable in other ways.

The administration of a large department will be carefully explained. Attention will be given to the cost of apparatus for instruction and research, the problems of construction and maintenance of plant, the care of storage batteries, the making of lantern slides, the cataloguing of physiological literature, the importation of apparatus, and many other details essential to the successful operation of a physiological laboratory. Men intending to devote themselves to clinical medicine, will, of course, give less time to these things and will concern themselves chiefly with matters bearing directly on their chosen work.

It is evident that these appointments will afford an admirable training to those intending to make physiology or any other of the biological sciences a profession. To the physician they offer a training not less valuable in the opinion of those who believe that research in the fundamental sciences is the best introduction to the higher walks of medicine.

Applicants for these positions should possess an elementary knowledge of physiology and a sufficient training in one or more of the biological sciences to enable them to profit by the instruction offered. Successful applicants are

required to take twelve half-days' instruction in the details of the course in experimental physiology, before October 1st of their year of service.

No charge of any kind will be made for the year's training.

The Harvard Medical School will give successful applicants the title of 'Assistant in Physiology,' and for the direction of the classes in experimental physiology will pay each Assistant four hundred dollars.

Applications may be sent to

PROFESSOR H. P. BOWDITCH.
HARVARD MEDICAL SCHOOL, BOSTON, MASS.

NOTE ON NATRIX GROHAMII B. & G.

IN Professor O. P. Hays' report on the Batrachians and Reptiles of Indiana* he says, on p. 589, "The young are no doubt brought forth alive and active." There is now no question about the fact of their being viviparous, as several were born alive in the Chicago Academy of Sciences, July 29th.

The adult female, measuring 775 mm. in length, was collected at Glenn Ellyn, Illinois, on July 25th, by Mr. Frank M. Woodruff, and its extreme size was particularly noted; four days later it gave birth to eight young, which were alive and very active. The births took place some time during the night, and the young were noticed on the following morning a little after 7 o'clock. They were at that time fully active and resembled somewhat the parent, although differing in some of the color markings. The young measured 246 mm. in length and were colored as follows: Back slaty-blue with two very dark dorsal stripes; a dark stripe borders the edge of the blue dorsal surface and separates it from the yellowish lateral surface; this is in turn separated from the greenish-yellow ventral surface by a black stripe, which follows the edges of the plates in a zigzag manner and disappears on the side of the head.

The young were kept alive for several weeks and finally preserved, with the parent, in the Academy's collection (Mus. No. 10,337 adult; 10,335 young). As another point of interest we might mention that a specimen of the Western Bull Snake (*Pitnophis sayi Schleg*), measuring nine feet in length, laid twenty-two eggs in captivity during the first week in August. The female was in the same cage with a small male for about two months previous to the laying, and it is probable that copulation took place during captivity.

FRANK C. BAKER,
FRANK M. WOODRUFF.

*Indiana. Department of Geology and Natural Resources, 17th Annual Report, 1891.

PSEUDO-AURORA AGAIN.

IN SCIENCE, First Series, for December 2 and 16, 1892, there was a short discussion of this subject, and now appears a still longer letter on the same subject in SCIENCE for January 29, 1897. It seems a little strange that so simple a phenomenon should give rise to so diverse views, and yet when we consider how many views have been given of a precisely similar phenomenon, 'The Brooken Spectre,' it is not so surprising. It is probable that this latest description is given from memory and not from notes made at the time—an exceedingly important proceeding if one would keep from falling into grievous errors. Every electric arc light has a support at the top, and this would absolutely prevent any column of pure white light being projected toward the zenith. More than this, if these assumed horizontal planes of ice reflected the light it seems impossible to consider that the reflections would be only from a region directly above the lamp.

If one will turn to the description in SCIENCE, December 2, 1892, he will see how it is almost exactly contrary to this later one, and yet the former undoubtedly presents a better idea of the phenomenon. When the air is full of frost particles or fog any object standing before a light will cast a shadow into the mass of frost particles or fog. If one will stand underneath an arc light when the air has fog in it he will see what appears like a beam projected into the fog. The same may also be seen when any foot rest or projecting arm intercepts the light; in this case a horizontal beam will be seen passing into the fog. Just at sunset if one stands upon a broad plain with his back to the sun he will see his shadow cast upon the ground and extending more than 100 feet to the eastward. Now imagine the surface on which the shadows cast to be practically on all sides like fog; then

the shadow will be cast into the fog and appear gigantic. This is probably an explanation of the 'pseudo-aurora.'

H. A. Hazen.

January 29, 1897.

[The above letter entirely mistakes the point of Goode's explanation of the pseudo-aurora. The fact that the electric lights have shields above them, which cut off vertical rays, as stated by Hazen, is irrelevant; for Goode does not think that the apparently vertical pseudo-auroral rays are really vertical; but that they are due to oblique rays emitted from the light at various angles of inclination, and reflected from under surface of horizontal snow plates, so that the locus of the reflection stands in a vertical plane through the observer, and the light wherever the observer is; hence the subjective impression that the ray is really a vertical beam of light. There is no analogy between these apparently vertical illuminated rays and the true dark shadows mentioned by Hazen.—Ed. Science.]

GREENLAND GLACIERS.

To the Editor of Science: The angular and apparently unglaciated peaks in Greenland mentioned by Professor Tarr in your issue of to-day are represented in Pennsylvania by similarly angular ridges covered by angular and local débris. It seems that advancing ice has no power to surmount a moderately sharp slope, but masses at its base and accumulates till the summit is reached, when a thrust plane is developed in the glacier above which the moving mass proceeds across the summit. This has been noted by the writer (Am. Jour. Sci., March, 1895, p. 181) at Bethlehem and in Mifflin township. Since the publication of the above other instances have been found which show that the glacier pours into a valley and fills it, or masses against a steep, opposing slope, develops the shear and remains practically stagnant below the thrust plane, or would remain so were it not for its ablation and the erosion due to subglacial torrents, which cause it to settle *down* the slope and down the valley trough, and thus become an accentuated creep which strews the valley with local fragments from the summit. The constantly forming sub-glacial void, due to the causes just stated, induces a downward movement in the ice above the thrust plane, and the crest of the ridge is frequently found crushed by vertical forces. In the Mahanoy region the vertical outcrop of hard sandstone is thus crushed flat to a depth of ten feet on the crest, and bent to north on the northern slope and to the south on the opposite side. This is but one instance where valleys have been glaciated while the summits of the ridges remain angular, and the fact that there is always difficulty in tracing moraine lines over ridges may be accounted for by the fact that ridge deposits are not allowed to remain *in situ* but creep down the slopes to the valley troughs. The finding of angular ridges or peaks, therefore, is, as Professor Tarr states, no sign of the absence of ice from the locality.

Edward H. Williams, jr.

Lehigh University.

SCIENTIFIC LITERATURE.

L' evolution de l' esclavage. Par Ch. Letourneau. Paris, Vigot Frerès. 1897. 1 vol. 8vo. Pp. 538.

It is a sad fact, emphasized by Professor Letourneau, that in all times and places most of the work of the world has been imposed upon the minority of the inhabitants. In old times, and in some places to-day, this was accomplished by the simple means of brute force, reducing the conquered and the feeble to the condition of slavery. The development of this tendency in the past, and its possible future effects, are the theme of the work before us.

It begins with the lower species, pointing out that in the societies of ants and termites there are slaves and servile revolts, quite like those in human history. Among men of the inferior races—and not these only—the regular slave is the woman. In many of the negro peoples she is literally a beast of burden, and is rated no higher than one. The women are bought and sold; they are given away and, when incapable of further profitable labor, are killed and eaten, or turned out to starve.

The long list of examples of this character collected by our author leaves a disagreeable sense of the meaness and baseness of masculine

nature. It inevitably led, as he points out, to a degeneration both of the slave and the master, both of the woman and the man, and destroyed the possibility of any notable progress in civilization.

In the chapter on slavery among the American aborigines he adduces a few examples, but recognizes that it was not a prevalent institution with the red race. The gynocracy found in some tribes, he explains as merely apparent, not a real government, but confined to industrial aims. On the slaves of Mexico and Peru, he is somewhat full, but confines himself to second-hand authorities and not always the best of these.

From America he passes to the Polynesians and the Mongolians, where the condition of the enslaved classes was as wretched as anywhere. Turning to ancient history, he collects from classical authorities a mass of information on slavery among the Semites, the Egyptians, the Greeks and the Romans. Of course, on the latter he is particularly ample, as the sources of accurate knowledge are abundant. Everywhere he finds the same characteristics evolving in like social environments.

The semi-servile conditions in the Middle Ages, such as those of the serfs, the adscripts of the glebe, and the like feudal dispositions of the lower classes, occupy an instructive chapter.

Finally, the author applies himself to the practical application of his long study of enforced labor. How is it to be avoided? Or so modified as to distribute even taxes on all? To this he devotes his closing pages; but they are too vague, too visionary, too remote from any possible immediate adoption, to satisfy the earnest reader. Slavery, in its ancient forms, is practically extinct; but is not modern freedom, in the face of labor unions on the one hand and monopolies on the other, just what Dr. Johnson defined it a hundred years ago and more, freedom to work or starve? An excellent index closes the volume.

D. G. BRINTON.

The Geological and Natural History Survey of Minnesota. N. H. WINCHELL, State Geologist. 1892–1896. The Geology of Minnesota, Vol. III. Part II. of the Final Report. Paleontology, by E. O. Ulrich, John M. Clarke, Wilbur H. Scofield, and N. H. Winchell. 4to. Minneapolis, 1897. Pp. lxxxiii. to cliv., 475–1081, plates 35–82, and 133 figures in the text.

The introductory chapter by N. H. Winchell and E. O. Ulrich gives a detailed correlation of the Lower Silurian deposits of the Upper Mississippi province, with those in the Cincinnati, Tennessee, New York, and Canadian provinces, together with the stratigraphic and geographic distribution of the fossils. It is doubtful whether any State Survey has ever before attempted so successfully such a minute study and correlation of the beds and horizons of an extensive series of sediments. It shows a vast amount of careful and intelligent collecting. This kind of work has made possible the preparation of the succeeding excellent chapters on various classes of fossil remains from the Lower Silurian or Ordovician.

E. O. Ulrich, under separate chapters, treats of the Lamellibranchiata and Ostracoda. These classes of animals are generally recognized as difficult to deal with in the fossil state, the former from the common imperfection of preservation, and the latter from their minute size and simple form. The paleozoic lamellibranchs are arranged under twenty-nine families, of which ten will include all or nearly all of the Ordovician genera.

The Trilobites are described by J. M. Clarke, in Chapter VIII. The material is not so rich as in some of the other classes, but is thoroughly elaborated. Valuable sections are added dealing with the American Lower Silurian Phacopidæ, and the subordinate generic relations of the species of the genera *Ceraurus* and *Lichas*. Chapter IX. on the Cephalopoda is by the same author. About fifty species are noticed, including the novel primitive nautiloid type, *Nanno*, about which there has already been considerable discussion in America, England and Sweden.

The final chapter (X.) on the Gastropoda, by E. O. Ulrich and the late W. H. Scofield, occupies more than one-third of the volume. Numerous new genera and species are described and illustrated, showing the richness and variety of this fauna.

C. E. BEECHER.

Municipal Government in Continental Europe. Albert Shaw. New York, The Century Co. 1895. Pp. 505.

The energetic editor of the *Review of Reviews* has embodied in the volume before us the results of much persistent investigation. The facts so industriously collected are sure to be of great value to such of our American municipalities as are beginning to struggle towards the light. Whatever be one's opinion regarding the theory of municipal ownership of street railways, lighting plants, ship canals, etc., there can be no doubt that it is both useful and suggestive to have the facts derived from foreign experience made known to us. There will, moreover, be general agreement that we can profit largely by the varied experiments of European towns in municipal sanitation.

Mr. Shaw's attitude is at times, it must be confessed, one of breathless admiration. The phrases 'bold project,' 'splendid public work,' 'uniformly brilliant results,' punctuate descriptions of undertakings and 'achievements' at which many critics still shake their heads. Can it be, we find ourselves asking, that every municipality has solved its sanitary problems in just the right way? Must it not be admitted that not a few European towns are still in the thick of experiment, still groping towards a solution of difficult problems which beset them, still far from confident that the demands of the situation have been really met?

Paris, under the caption 'the typical modern city,' receives by far the most elaborate treatment at the hands of our author, and there will be little dissent, we fancy, from his explanation in the preface: "I can hardly think that any reader will fail to agree that Paris is the necessary starting point for a description of the modern régime in Continental cities." Here, as in the well-known companion volume, '*Municipal Government in Great Britain*,' already reviewed in this Journal, important questions of sanitation are treated as municipal problems of the first magnitude.

The double service of water supply devised for Paris by M. Belgrand is, perhaps, as Mr. Shaw appears ready to believe, theoretically admirable, but in practice it has not been found to work altogether smoothly. The supply of spring water has been almost always too scanty and the insufficient quantity has been eked out by the water of the polluted Seine. So well recognized is the injurious effect of the Seine water that warning is given through the public press when the river water is to be turned into the pipes, and when water from the Seine has been substituted for more than twenty days in the year the householder has the right to a reduction of rates. The water brought from a distance has, moreover, not proved all that could be desired. An epidemic of typhoid fever, which broke out in Paris in 1894, was traced by the authorities to the supply from the Vanne, in which full confidence had hitherto been placed. We are inclined to demur here at the encomiums bestowed by Mr. Shaw on the double system, and to believe that the day has not come when one may safely predict with him, "In due time * * * the double system will have been carried out in an ideal manner for all Paris." (p. 67.)

On p. 335 the statement occurs, during the admirable discussion of the functions of the German city, that "the quantity of water used by a city is regarded by British sanitary authorities as, in a rough way, a measure of its relative civilization." On this point we believe our author missed an admirable opportunity for pointing a moral, a kind of opportunity which, it must be said, he does not often allow to slip unheeded. The excessive quantity of water 'used' in the United Sates is not exactly an indication of our superiority in things sanitary. The disparity between the quantity of water per capita pumped into the mains in Europe and that supplied in the United States is, indeed, little to our credit, although no one will dispute Mr. Shaw's statement that "an abundant supply of pure water, thoroughly distributed, is a vital consideration for any city." While London gets along with 44 gallons a head daily, Hamburg with 58, Dresden with 22 and Berlin with 17, New York and Boston must have 92 gallons, Chicago 131, Philadelphia 162, Pittsburg 220 and Allegheny 247. It is well known that at least a partial remedy for this condition lies in the introduction of the meter and other devices, and yet this disgraceful waste of water is steadily increasing in most large American municipalities

despite the protests of responsible superintendents and engineers.

The methods of sewage disposal in use on the Continent are discussed in a generally accurate, though non-technical fashion. The Paris and Berlin sewage farms are described in course. The Gennevilliers irrigation fields in the sandy peninsula opposite St. Denis are not, as might perhaps be inferred from Mr. Shaw's statement, directly controlled by the municipality, but the individual occupants regulate at will the amount of sewage turned into the trenches. At Berlin the sewage farm system has achieved its most brilliant success. A great variety of crops is grown upon these farms; on one farm roses are cultivated for the purpose of manufacturing the perfume attar of roses.

The housing of the working classes deservedly receives a good deal of attention, particularly in connection with the author's study of the German cities, where the overcrowding is in some cases almost incredible. In Breslau in 1885 no fewer than 150,000 people out of a population of 287,000 lived in habitations containing only one room that could be warmed. In Berlin in 1890 the average number of inhabitants in a dwelling house (Grundstück) was 73 as against an average of 67 in 1885. The point is taken, however, that the German municipal authorities have the facts of the case well in hand and are trying to remedy the evil.

Our author notes here and there various interesting facts relating to the general sanitary oversight and organization in European towns. The control of food supplies, the supervision of abattoirs and the disinfection service all receive merited attention. Where so much is included it would be ungracious to remark the omission of some interesting and important topics.

The chapter on *Hamburg and its Sanitary Reforms* takes careful note of the wave of reform that has lately swept over the great port. The dearly-bought lesson of the cholera outbreak of 1892–'93 has not been thrown away, and the energetic administration of Dr. Dunbar and his staff of expert assistants has not only made a brilliant success of the attempt to purify the Elbe water, but has also wrought great improvement in the general sanitary condition of the city. The story is told by Mr. Shaw in his best vein. We trust, however, that the following statement: "In July, 1893, the imperial health authorities at Berlin issued a warning to the municipal governments of the country not to supply their citizens with a drinking water containing more than 100 *cholera* germs to the cubic centimeter" (p. 398), will not be taken as a literal transcript of the German decree. Mr. Shaw should have been told that all germs netted in the Elbe were not cholera germs.

EDWIN O. JORDAN.

SOCIETIES AND ACADEMIES.

TORREY BOTANICAL CLUB, JANUARY 27, 1897.

THE scientific program was as follows:

Dr. H. H. Rusby, 'Remarks on some Solanaceæ.'

Mr. A. A. Tyler, 'The Origin and Functions of Stipules.'

Dr. J. K. Small, '*Aster gracilis* Nuttall.'

Mr. George V. Nash, 'New and Noteworthy American Grasses.'

Dr. Rusby exhibited a number of Solanaceous plants and remarked upon their relationships. It was pointed out that the general appearance and chemical and physiological characteristics of these plants frequently fail to indicate their structural affinities. Cestrum and Sessea, Atropa and Datura were cited as illustrations of the separation of otherwise naturally related groups through their possession respectively of baccate and capsular fruits. Nicotiana was referred to as connecting those tribes having a radical symmetry with the tribe Salpiglossidæ, having a bilateral symmetry and thus connecting the family with the Labiales. The Androcera and Andropeda sections of the genus *Solanum* were instances of the appearance of this bilateral symmetry in a widely separated part of the family where radial symmetry is the otherwise invariable rule.

Dr. Britton discussed the subject and remarked upon this instance of development of two divisions of a group along different lines, in this case through baccate and capsular fruits. He cited similar parallelisms in other families tending to produce different resulting characters, as in *Capparidaceæ*, and remarked that an indication of the lines along which these genera

have been derived may be read in these characters.

The second paper by Mr. A. A. Tyler, on 'The Nature and Origin of Stipules,' presented conclusions derived from studies extending through several years. The subject was treated at length in the light of geological, morphological, anatomical and developmental evidence. Discussing Mr. Tyler's paper, which will shortly be published in full, Dr. Britton remarked that "the outcome of this very important paper is most interesting; it emphasizes the significance of basal scales and those of buds and rootstocks; and it is the more convincing from the nicety with which it accords with the seemingly haphazard distribution of stipules widely but irregularly here and there through the vegetable kingdom."

Mrs. Britton discussed the paper further, referring to the different phases presented in *Fissidens*.

Of the remaining papers, that by Mr. Nash was read by title and will appear in the *Bulletin;* and that by Dr. Small was, on account of the lateness of the hour, deferred till the next meeting.

Edward S. Burgess,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF ASTRONOMY AND PHYSICS, MARCH 1, 1897.

F. L. Tuffts presented an abstract of work recently done by him in further testing the correctness of the results obtained with the original form of the Rood flicker photometer. By a very elaborate series of tests by various methods, he found that the true 'flicker,' which appears when the speed is just sufficient to give a uniform background, is independent of color and depends only upon differences of luminosity.

The paper was discussed by R. S. Woodward and W. Hallock. W. Hallock described several forms of maximum thermometers used in subterranean temperature work, and described a new form which it is believed will obviate some of the difficulties of the U. S. signal service form, which has been used so successfully.

Mr. Hallock also reported upon recent work on subterranean temperatures referring especially to the Sperenberg well, near Berlin, 4,300 feet; the Wheeling, W. Va., well, 4,500 feet; the new Pittsburg well, 5,386 feet; the Schladebach well, near Leipzig, 5,740 feet, and the incomplete well at Paruschowitch, near Reibnik, which two years ago was 6,600 feet deep and was planned to go 2,700 meters (8,800 feet). The well at Pittsburg gave results practically identical with those obtained in the Wheeling well, which is forty miles distant but in practically the same geological strata. The observations at Pittsburg were preliminary, and it is hoped that a very complete and satisfactory series of temperatures will be obtained, owing to the generous public spirit of the Forest Oil Co., who have practically placed the well at the service of science. It is planned to drill it much deeper.

W. Hallock,
Secretary of Section.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis, of March 1, 1897, Mr. William H. Rush presented a demonstration of the formation of carbon dioxide and alcohol as a result of the intramolecular respiration of seeds and other vegetable structures in an atmosphere containing no free oxygen. The theory of the dissolution and reconstruction of the living nitrogenous molecules was explained in connection with the experiments, and the different behavior of these molecules when supplied with or deprived of free oxygen was indicated.

Mr. H. von Schrenk briefly described certain œdematous enlargements which he had observed at the beginning of the present winter, near the root tips of specimens of *Salix nigra*, growing along the edge of a body of water. The speaker compared these with the œdemata of tomato leaves and apple twigs which were studied some years since at Cornell University.

Professor J. H. Kinealy exhibited a glass model illustrating the mode of action of the Pohle air-lift pump, the efficiency of which he had discussed at the preceding meeting.

One name was proposed for active membership.

William Trelease,
Recording Secretary.